

PALÆONTOGRAPHICAL SOCIETY.

VOL. L.

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PART III.

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JURASSIC GASTEROPODA.

PART I, No. 9 (CONCLUSION).

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SOUTH OF ENGLAND.

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## VOLUME L.

### CONTAINING

THE CRAG FORAMINIFERA. Part III. By Prof. T. R. JONES.

THE JURASSIC GASTEROPODA, INFERIOR OOLITE. Part I, No. IX (Conclusion). By Mr. W. H. HUDLESTON. Four Plates.

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Geology  
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# LIST

OF

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AND

- I. A CATALOGUE OF THE WORKS ALREADY PUBLISHED ;
- II. A CLASSIFIED LIST OF THE MONOGRAPHS COMPLETED, IN COURSE OF PUBLICATION,  
AND IN PREPARATION, WITH THE NAMES OF THEIR RESPECTIVE AUTHORS ;
- III. THE DATES OF ISSUE OF THE ANNUAL VOLUMES ;
- IV. A GENERAL SUMMARY, SHOWING THE NUMBER OF THE PAGES, PLATES, FIGURES,  
AND SPECIES IN EACH MONOGRAPH ;
- V. A STRATIGRAPHICAL LIST OF THE BRITISH FOSSILS FIGURED AND DESCRIBED IN THE  
YEARLY VOLUMES.
- VI. EXTRACT FROM THE REPORT OF THE COUNCIL TO THE ANNUAL GENERAL MEETING,  
19TH JUNE, 1896, GIVING A BRIEF HISTORY OF THE SOCIETY.

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## § I. CATALOGUE OF WORKS

ALREADY PUBLISHED BY

### THE PALÆONTOGRAPHICAL SOCIETY:

*Showing the ORDER of publication; the YEARS during which the Society has been in operation; and the CONTENTS of each yearly Volume.*

Vol. I.	Issued for the Year 1847	The Crag Mollusca, Part I, Univalves, by Mr. S. V. Wood, 21 plates.
„ II.	„ 1848	<div> <div>The Reptilia of the London Clay, Vol. I, Part I, Chelonia, &amp;c., by Profs. Owen and Bell, 38 plates.</div> <div>The Eocene Mollusca, Part I, Cephalopoda, by Mr. F. E. Edwards, 9 plates.</div> </div>
„ III.*	„ 1849	<div> <div>The Entomostraca of the Cretaceous Formations, by Mr. T. R. Jones, 7 plates.</div> <div>The Permian Fossils, by Prof. Wm. King, 29 plates.</div> <div>The Reptilia of the London Clay, Vol. I, Part II, Crocodilia and Ophidia, &amp;c., by Prof. Owen, 18 plates.</div> <div>The Fossil Corals, Part I, Crag, London Clay, Cretaceous, by Messrs. Milne Edwards and Jules Haime, 11 plates.</div> </div>
„ IV.	„ 1850	<div> <div>The Crag Mollusca, Part II, No. 1, by Mr. S. V. Wood, 12 plates.</div> <div>The Mollusca of the Great Oolite, Part I, Univalves, by Messrs. Morris and Lycett, 15 plates.</div> <div>The Fossil Brachiopoda, Vol. I, Part III, No. 1, Oolitic and Liassic, by Mr. Davidson, 13 plates.</div> </div>

\* The Volume for the year 1849 consists of two separate portions, each of which is stitched in a paper cover, on which are printed the dates 1848, 1849, and 1850. The one portion contains 'Cretaceous Entomostraca' and 'Permian Fossils,' the other, 'London Clay Reptilia,' Part II, and 'Fossil Corals,' Part I.

## CATALOGUE OF WORKS—Continued.

Vol. V.	Issued for the Year 1851	{	The Reptilia of the Cretaceous Formations, by Prof. Owen, 39 plates. The Fossil Corals, Part II, Oolitic, by Messrs. Milne Edwards and Jules Haime, 19 plates. The Fossil Lepadidæ, by Mr. Charles Darwin, 5 plates.
„ VI.	„	1852	{
			The Fossil Corals, Part III, Permian and Mountain-limestone, by Messrs. Milne Edwards and Jules Haime, 16 plates.
			The Fossil Brachiopoda, Vol. I, Part I, Tertiary, by Mr. Davidson, 2 plates.
			The Fossil Brachiopoda, Vol. I, Part II, No. 1, Cretaceous, by Mr. Davidson, 5 plates.
			The Fossil Brachiopoda, Vol. I, Part III, No. 2, Oolitic, by Mr. Davidson, 5 plates.
			The Eocene Mollusca, Part II, Pulmonata, by Mr. F. E. Edwards, 6 plates.
			The Radiaria of the Crag, London Clay, &c., by Prof. E. Forbes, 4 plates.
„ VII.	„	1853	{
			The Fossil Corals, Part IV, Devonian, by Messrs. Milne Edwards and Jules Haime, 10 plates.
			The Fossil Brachiopoda, Introduction to Vol. I, by Mr. Davidson, 9 plates.
			The Mollusca of the Chalk, Part I, Cephalopoda, by Mr. D. Sharpe, 10 plates.
			The Mollusca of the Great Oolite, Part II, Bivalves, by Messrs. Morris and Lycett, 8 plates.
			The Mollusca of the Crag, Part II, No. 2, Bivalves, by Mr. S. V. Wood, 8 plates.
			The Reptilia of the Wealden Formations, Part I, Chelonia, by Prof. Owen, 9 plates.
„ VIII.*	„	1854	{
			The Fossil Brachiopoda, Vol. I, Part II, No. 2, Cretaceous, with Appendix and Index to Vol. I, by Mr. Davidson, 8 plates.
			The Reptilia of the Wealden Formations, Part II, Dinosauria, by Prof. Owen, 20 plates.
			The Mollusca of the Great Oolite, Part III, Bivalves, by Messrs. Morris and Lycett, 7 plates.
			The Fossil Corals, Part V, Silurian, by Messrs. Milne Edwards and Jules Haime, 16 plates.
			The Fossil Balanidæ and Verrucidæ, by Mr. Charles Darwin, 2 plates.
			The Mollusca of the Chalk, Part II, Cephalopoda, by Mr. D. Sharpe, 6 plates.
			The Eocene Mollusca, Part III, No. 1, Prosobranchiata, by Mr. F. E. Edwards, 8 plates.
„ IX.†	„	1855	{
			The Mollusca of the Crag, Part II, No. 3, Bivalves, by Mr. S. V. Wood, 11 plates.
			The Reptilia of the Wealden Formations, Part III, by Prof. Owen, 12 plates.
			The Eocene Mollusca, Part III, No. 2, Prosobranchiata, continued, by Mr. F. E. Edwards, 4 plates.
			The Mollusca of the Chalk, Part III, Cephalopoda, by Mr. D. Sharpe, 11 plates.
			The Tertiary Entomostraca, by Mr. T. R. Jones, 6 plates.
			The Fossil Echinodermata, Oolitic, Vol. I, Part I, by Dr. Wright, 10 plates.
„ X.	„	1856	{
			The Fossil Echinodermata, Oolitic, Vol. I, Part II, by Dr. Wright, 12 plates.
			The Fossil Crustacea, Part I, London Clay, by Prof. Bell, 11 plates.
			The Fossil Brachiopoda, Vol. II, Part IV, Permian, by Mr. Davidson, 4 plates.
			The Fossil Brachiopoda, Vol. II, Part V, No. 1, Carboniferous, by Mr. Davidson, 8 plates.
			The Reptilia of the Wealden Formations, Part IV (Supplement No. 1), by Prof. Owen, 11 plates.
			The Reptilia of the London Clay, Vol. I (Supplement), by Prof. Owen, 2 plates.
„ XI.	„	1857	{
			The Fossil Echinodermata, Oolitic, Vol. I, Part III, by Dr. Wright, 14 plates.
			The Fossil Brachiopoda, Vol. II, Part V, No. 2, Carboniferous, by Mr. Davidson, 8 plates.
			The Reptilia of the Cretaceous Formations (Supplement No. 1), by Prof. Owen, 4 plates.
			The Reptilia of the Wealden Formations (Supplement No. 2), by Prof. Owen, 8 plates.
			The Polyzoa of the Crag, by Prof. Busk, 22 plates.
„ XII.	„	1858	{
			The Fossil Echinodermata, Oolitic, Vol. I, Part IV, by Dr. Wright, 7 plates.
			The Eocene Mollusca, Part III, No. 3, Prosobranchiata continued, by Mr. F. E. Edwards, 6 plates.
			The Reptilia of the Cretaceous Formations (Supplements No. 2, No. 3), by Prof. Owen, 7 plates.
			The Reptilia of the Purbeck Limestones, by Prof. Owen, 1 plate.
			The Fossil Brachiopoda, Vol. II, Part V, No. 3, Carboniferous, by Mr. Davidson, 10 plates.
„ XIII.	„	1859	{
			The Fossil Brachiopoda, Part V, No. 4, Carboniferous, by Mr. Davidson, 20 plates.
			The Reptilia of the Oolitic Formations, No. 1, Lower Lias, by Prof. Owen, 6 plates.
			The Reptilia of the Kimmeridge Clay, No. 1, by Prof. Owen, 1 plate.
			The Eocene Mollusca, Part IV, No. 1, Bivalves, by Mr. S. V. Wood, 13 plates.

\* This Vol. is marked on the outside 1855.

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## CATALOGUE OF WORKS—Continued.

Vol. XIV.	Issued for the Year 1860	<ul style="list-style-type: none"> <li>The Fossil Brachiopoda, Vol. II, Part V, No. 5, Carboniferous, by Mr. Davidson, 8 plates.</li> <li>The Reptilia of the Oolitic Formations, No. 2, Lower Lias, by Prof. Owen, 11 plates.</li> <li>The Reptilia of the Kimmeridge Clay, No. 2, by Prof. Owen, 1 plate.</li> <li>The Fossil Estheriæ, by Prof. Rupert Jones, 5 plates.</li> <li>The Fossil Crustacea, Part II, Gault and Greensand, by Prof. Bell, 11 plates.</li> </ul>
„ XV.	„ 1861	<ul style="list-style-type: none"> <li>The Fossil Echinodermata, Oolitic, Vol. II, Part I (Asteroidea), by Dr. Wright, 13 plates.</li> <li>Supplement to the Great Oolite Mollusca, by Dr. Lycett, 15 plates.</li> </ul>
„ XVI.	„ 1862	<ul style="list-style-type: none"> <li>The Fossil Echinodermata, Cretaceous, Vol. I, Part I, by Dr. Wright, 11 plates.</li> <li>The Trilobites of the Silurian, Devonian, &amp;c., Formations, Part I (Devonian and Silurian), by Mr. J. W. Salter, 6 plates.</li> <li>The Fossil Brachiopoda, Vol. III, Part VI, No. 1, Devonian, by Mr. Davidson, 9 plates.</li> <li>The Eocene Mollusca, Part IV, No. 2, Bivalves, by Mr. S. V. Wood, 7 plates.</li> <li>The Reptilia of the Cretaceous and Wealden Formations (Supplements), by Prof. Owen, 10 plates.</li> </ul>
„ XVII.	„ 1863	<ul style="list-style-type: none"> <li>The Trilobites of the Silurian, Devonian, &amp;c., Formations, Part II, by Mr. J. W. Salter, 8 plates.</li> <li>The Fossil Brachiopoda, Vol. III, Part VI, No. 2, Devonian, by Mr. Davidson, 11 plates.</li> <li>The Belemnitidæ, Part I, Introduction, by Prof. Phillips.</li> <li>The Reptilia of the Liassic Formations, Part I, by Prof. Owen, 16 plates.</li> </ul>
„ XVIII.	„ 1864	<ul style="list-style-type: none"> <li>The Fossil Echinodermata, Oolitic, Vol. II, Part II (Liassic Ophiuroidea), by Dr. Wright, 6 plates.</li> <li>The Trilobites of the Silurian, Devonian, &amp;c., Formations, Part III, by Mr. J. W. Salter, 11 plates.</li> <li>The Belemnitidæ, Part II, Liassic Belemnites, by Prof. Phillips, 7 plates.</li> <li>The Pleistocene Mammalia, Part I, Introduction, Felis spelæa, by Messrs. W. Boyd Dawkins and W. A. Sanford, 5 plates.</li> <li>Title-pages, &amp;c., to the Monographs on the Reptilia of the London Clay, Cretaceous, and Wealden Formations.</li> </ul>
„ XIX.*	„ 1865	<ul style="list-style-type: none"> <li>The Crag Foraminifera, Part 1, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady, 4 plates.</li> <li>Supplement to the Fossil Corals, Part I, Tertiary, by Dr. Duncan, 10 plates.</li> <li>The Fossil Merostomata, Part I, Pterygotus, by Mr. H. Woodward, 9 plates.</li> <li>The Fossil Brachiopoda, Vol. III, Part VII, No. 1, Silurian, by Mr. Davidson, 12 plates.</li> </ul>
„ XX.*	„ 1866	<ul style="list-style-type: none"> <li>Supplement to the Fossil Corals, Part IV, No. 1, Liassic, by Dr. Duncan, 11 plates.</li> <li>The Trilobites of the Silurian, Devonian, &amp;c., Formations, Part IV (Silurian), by Mr. J. W. Salter, 6 plates.</li> <li>The Fossil Brachiopoda, Vol. III, Part VII, No. 2, Silurian, by Mr. Davidson, 10 plates.</li> <li>The Belemnitidæ, Part III, Liassic Belemnites, by Prof. Phillips, 13 plates.</li> </ul>
„ XXI.*	„ 1867	<ul style="list-style-type: none"> <li>Flora of the Carboniferous Strata, Part I, by Mr. E. W. Binney, 6 plates.</li> <li>Supplement to the Fossil Corals, Part IV, No. 2, Liassic, by Dr. Duncan, 6 plates.</li> <li>The Fossil Echinodermata, Cretaceous, Vol. I, Part II, by Dr. Wright, 14 plates.</li> <li>The Fishes of the Old Red Sandstone, Part I, by Messrs. J. Powrie and E. Ray Lankester, 5 plates.</li> <li>The Pleistocene Mammalia, Part II, Felis spelæa, continued, by Messrs. W. Boyd Dawkins and W. A. Sanford, 14 plates.</li> </ul>
„ XXII.*	„ 1868	<ul style="list-style-type: none"> <li>Supplement to the Fossil Corals, Part II, No. 1, Cretaceous, by Dr. Duncan, 9 plates.</li> <li>The Fossil Merostomata, Part II, Pterygotus, by Mr. H. Woodward, 6 plates.</li> <li>The Fossil Brachiopoda, Vol. III, Part VII, No. 3, Silurian, by Mr. Davidson, 15 plates.</li> <li>The Belemnitidæ, Part IV, Liassic and Oolitic Belemnites, by Prof. Phillips, 7 plates.</li> <li>The Reptilia of the Kimmeridge Clay, No. 3, by Prof. Owen, 4 plates.</li> <li>The Pleistocene Mammalia, Part III, Felis spelæa, concluded, with F. lynx, by Messrs. W. Boyd Dawkins and W. A. Sanford, 6 plates.</li> </ul>
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Vol. XXIV.*	Issued for the Year 1870		The Flora of the Carboniferous Strata, Part II, by Mr. E. W. Binney, 6 plates.
			The Fossil Echinodermata, Cretaceous, Vol. I, Part IV, by Dr. Wright, 10 plates.
			The Fossil Brachiopoda, Vol. III, Part VII, No. 4, Silurian, by Mr. Davidson, 13 plates.
			The Eocene Mollusca, Part IV, No. 3, Bivalves, by Mr. S. V. Wood, 5 plates.
„ XXV.*	„	1871	The Fossil Mammalia of the Mesozoic Formations, by Prof. Owen, 4 plates.
			The Flora of the Carboniferous Strata, Part III, by Mr. E. W. Binney, 6 plates.
			The Fossil Merostomata, Part III, Pterygotus and Slimonia, by Mr. H. Woodward, 5 plates.
			Supplement to the Crag Mollusca, Part I (Univalves), by Mr. S. V. Wood, with an Introduction on the Crag District, by Messrs. S. V. Wood, jun., and F. W. Harmer, 7 plates and map.
„ XXVI.*	„	1872	Supplement to the Reptilia of the Wealden (Iguanodon), No. IV, by Prof. Owen, 3 plates
			The Pleistocene Mammalia, Part IV, Felis pardus, &c., by Messrs. W. Boyd Dawkins and W. A. Sanford, 2 plates.
			The Pleistocene Mammalia, Part V, Ovibos moschatus, by Mr. W. Boyd Dawkins, 5 plates.
			Supplement to the Fossil Corals, Part III (Oolitic), by Prof. Duncan, with an Index to the Tertiary and Secondary Species, 7 plates.
„ XXVII.*	„	1873	The Fossil Echinodermata, Cretaceous, Vol. I, Part V, by Dr. Wright, 5 plates.
			The Fossil Merostomata, Part IV (Stylonurus, Eurypterus, Hemiaspis), by Mr. H. Woodward, 10 plates.
			The Fossil Trigoniae, No. I, by Dr. Lycett, 9 plates.
			The Fossil Echinodermata, Cretaceous, Vol I, Part VI, by Dr. Wright, 8 plates.
„ XXVIII.*	„	1874	Supplement to the Fossil Brachiopoda, Vol. IV, Part I (Tertiary and Cretaceous), by Mr. Davidson, 8 plates.
			Supplement to the Crag Mollusca, Part II (Bivalves), by Mr. S. V. Wood, 5 plates.
			Supplement to the Reptilia of the Wealden (Iguanodon), No. V, by Prof. Owen, 2 plates.
			Supplement to the Reptilia of the Wealden (Hylæochampsæ) No. VI, by Prof. Owen.
„ XXIX.*	„	1875	The Fossil Reptilia of the Mesozoic Formations, Part I, by Prof. Owen, 2 plates.
			The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, 16 plates.
			The Carboniferous Entomostraca, Part I (Cyprinidæ), by Prof. T. Rupert Jones and Messrs. J. W. Kirkby and G. S. Brady, 5 plates.
			The Fossil Trigoniae, No. II, by Dr. Lycett, 10 plates.
„ XXX.*	„	1876	The Flora of the Carboniferous Strata, Part IV, by Mr. E. W. Binney, 6 plates.
			The Fossil Echinodermata, Cretaceous, Vol. I, Part VII, by Dr. Wright, 10 plates.
			The Fossil Trigoniae, No. III, by Dr. Lycett, 8 plates.
			The Fossil Reptilia of the Mesozoic Formations, Part II, by Prof. Owen, 20 plates.
„ XXXI.*	„	1877	The Carboniferous and Permian Foraminifera (the genus Fusulina excepted), by Mr. H. B. Brady, 12 plates.
			Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 1 (Jurassic and Triassic), by Mr. Davidson, 8 plates.
			Supplement to the Reptilia of the Wealden (Poikilopleuron and Chondrosteosaurus), No. VII, by Prof. Owen, 6 plates.
			Supplement to the Eocene Mollusca (Bivalves), by Mr. S. V. Wood, 2 plates.
„ XXXII.*	„	1878	The Fossil Trigoniae, No. IV, by Dr. Lycett, 13 plates.
			The Eocene Mollusca (Univalves), Part IV, by Mr. S. V. Wood, 1 plate.
			The Carboniferous Ganoid Fishes, Part I (Palæoniscidæ), by Dr. Traquair, 7 plates.
			The Fossil Reptilia of the Mesozoic Formations, Part III, by Prof. Owen, 2 plates.
„ XXXIII.*	„	1879	The Fossil Elephants (E. antiquus), Part I, by Prof. Leith Adams, 5 plates.
			The Fossil Echinodermata, Cretaceous, Vol. I, Part VIII, by Dr. Wright, 8 plates.
			Index and Title Page to the Fossil Echinodermata, Oolitic, Vol. I (Echinoidea), by Dr. Wright.
			The Fossil Merostomata, Part V (Neolimulus, &c.), by Dr. H. Woodward, 6 plates.
„ XXXIV.*	„	1880	Supplement to the Fossil Brachiopoda, Vol. IV, Part II, No. 2 (Jurassic and Triassic), by Mr. Davidson, 13 plates.
			The Lias Ammonites, Part I, by Dr. Wright, 8 plates.
			The Sirenoid and Crossopterygian Ganoids, Part I, by Prof. Miall, 6 plates.
			Supplement to the Reptilia of the Wealden (Goniopholis, Petrosuchus, and Sucho-saurus), No. VIII, by Prof. Owen, 6 plates.
„ XXXV.*	„	1881	The Pleistocene Mammalia, Part A (Preliminary Treatise), by Prof. Boyd Dawkins.

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## CATALOGUE OF WORKS—Continued.

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|---------------|-----------------------------|---|--|
| Vol. XXXIII.* | Issued for the<br>Year 1879 | { The Eocene Flora, Vol. I, Part I, by Mr. J. S. Gardner and Baron Ettingshausen, 5 plates.<br>Second Supplement to the Crag Mollusca (Univalves and Bivalves), by Mr. S. V. Wood, 6 plates.<br>The Fossil Trigonæ, No. V ( <i>Conclusion</i> ), by Dr. Lycett, 1 plate.<br>The Lias Ammonites, Part II, by Dr. Wright, 10 plates.<br>Supplement to the Reptilia of the Wealden (Goniopholis, Brachydictes, Nannosuchus, Theriosuchus, and Nuthetes), No. IX, by Prof. Owen, 4 plates.<br>The Fossil Elephants ( <i>E. primigenius</i> ), Part II, by Prof. Leith Adams, 10 plates. |  |
| „ XXXIV.*     | „                           | 1880  | { The Eocene Flora, Vol. I, Part II, by Mr. J. S. Gardner and Baron Ettingshausen, 6 plates.<br>The Fossil Echinodermata, Oolitic, Vol. II, Part III (Asteroidea and Ophiuroidea), by Dr. Wright, 3 plates.<br>Supplement to the Fossil Brachiopoda, Vol. IV, Part III (Permian and Carboniferous), by Mr. Davidson, 8 plates.<br>The Lias Ammonites, Part III, by Dr. Wright, 22 plates.<br>The Reptilia of the London Clay, Vol. II, Part I ( <i>Chelone</i> ) by Prof. Owen, 2 plates.  |
| „ XXXV.*      | „                           | 1881  | { The Fossil Echinodermata, Cretaceous, Vol. I, Part IX, by Dr. Wright, 6 plates.<br>Supplement to the Fossil Brachiopoda, Vol. IV, Part IV (Devonian and Silurian, from Budleigh-Salterton Pebble Bed), by Mr. Davidson, 5 plates.<br>The Fossil Trigonæ (Supplement No. 1), by Dr. Lycett.<br>The Lias Ammonites, Part IV, by Dr. Wright, 10 plates.<br>The Reptilia of the Liassic Formations, Part III ( <i>Conclusion</i> ), by Prof. Owen, 13 plates.<br>The Fossil Elephants ( <i>E. primigenius</i> and <i>E. meridionalis</i> ), Part III ( <i>Conclusion</i> ), by Prof. Leith Adams, 13 plates. |
| „ XXXVI.*     | „                           | 1882  | { The Eocene Flora, Vol. I, Part III ( <i>Conclusion</i> ), by Mr. J. S. Gardner and Baron Ettingshausen, 2 plates.<br>Third Supplement to the Crag Mollusca, by the late Mr. S. V. Wood, 1 plate.<br>The Fossil Echinodermata, Cret., Vol. I, Part X ( <i>Conclusion</i> ), by Dr. Wright, 5 plates.<br>Supplement to the Fossil Brachiopoda, Vol. IV, Part V ( <i>Conclusion</i> ), by Dr. Davidson.<br>Do., Vol. V, Part I (Devonian and Silurian), by Dr. Davidson, 7 plates.<br>The Lias Ammonites, Part V, by Dr. Wright, 22 plates.   |
| „ XXXVII.*    | „                           | 1883  | { The Eocene Flora, Vol. II, Part I, by Mr. J. S. Gardner, 9 plates.<br>The Trilobites of the Silurian, Devonian, &c., Formations, Part V ( <i>Conclusion</i> ), by the late Mr. J. W. Salter.<br>The Carboniferous Trilobites, Part I, by Dr. H. Woodward, 6 plates.<br>Supplement to the Fossil Brachiopoda, Vol. V, Part II (Silurian), by Dr. Davidson, 10 plates.<br>The Fossil Trigonæ (Supplement No. 2), by the late Dr. Lycett, 4 plates.<br>The Lias Ammonites, Part VI, by Dr. Wright, 8 plates.  |
| „ XXXVIII.*   | „                           | 1884  | { The Eocene Flora, Vol. II, Part II, by Mr. J. S. Gardner, 11 plates.<br>The Carboniferous Entomostraca, Part I, No. 2 ( <i>Conclusion</i> ), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady, 2 plates.<br>The Carboniferous Trilobites, Part II, by Dr. H. Woodward, 4 plates.<br>Supplement to the Fossil Brachiopoda, Vol. V, Part III ( <i>Conclusion</i> ), by Dr. Davidson, 4 plates.<br>The Lias Ammonites, Part VII, by Dr. Wright, 10 plates.   |
| „ XXXIX.*     | „                           | 1885  | { The Eocene Flora, Vol. II, Part III ( <i>Conclusion</i> ), by Mr. J. S. Gardner, 7 plates.<br>The Stromatoporoids, Part I, by Prof. Alleyne Nicholson, 11 plates.<br>The Fossil Brachiopoda (Bibliography), Vol. VI ( <i>Conclusion</i> ), by the late Dr. Davidson and Mr. W. H. Dalton.<br>The Lias Ammonites, Part VIII ( <i>Conclusion</i> ), by the late Dr. Wright, 1 plate.   |
| „ XL.*        | „                           | 1886  | { The Morphology and Histology of Stigmæria Ficoides, by Prof. W. C. Williamson, 15 plates.<br>The Fossil Sponges, Part I, by Dr. G. J. Hinde, 8 plates.<br>The Jurassic Gasteropoda, Part I, No. 1, by Mr. W. H. Hudleston.<br>The Inferior Oolite Ammonites, Part I, by Mr. S. S. Buckman, 6 plates.<br>The Pleistocene Mammalia, Part VI, by Prof. Boyd Dawkins, 7 plates.  |
| „ XLI.*       | „                           | 1887  | { The Fossil Sponges, Part II, by Dr. G. J. Hinde, 1 plate.<br>The Palæozoic Phyllopora, Part I, by Prof. T. R. Jones and Dr. Woodward, 12 plates.<br>The Jurassic Gasteropoda, Part I, No. 2, by Mr. W. H. Hudleston, 6 plates.<br>The Inferior Oolite Ammonites, Part II, by Mr. S. S. Buckman, 8 plates.  |

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## CATALOGUE OF WORKS—Continued.

Vol. XLII.*	Issued for the Year 1888	<ul style="list-style-type: none"> <li>The Stromatoporoids, Part II, by Prof. Alleyne Nicholson, 8 plates.</li> <li>The Tertiary Entomostraca (Supplement), by Prof. T. Rupert Jones and Mr. C. D. Sherborn, 3 plates.</li> <li>The Jurassic Gasteropoda, Part I, No. 3, by Mr. W. H. Hudleston, 5 plates.</li> <li>The Inferior Oolite Ammonites, Part III, by Mr. S. S. Buckman, 10 plates.</li> <li>The Devonian Fauna of the South of England, Part I, by the Rev. G. F. Whidborne, 4 plates.</li> <li>Title-pages to the Monographs on the Reptilia of the Wealden and Purbeck (Supplements), Kimmeridge Clay, and Mesozoic Formations, and on the Cetacea of the Red Crag.</li> </ul>
„ XLIII.*	„ 1889	<ul style="list-style-type: none"> <li>The Cretaceous Entomostraca (Supplement), by Prof. T. Rupert Jones and Dr. G. J. Hinde, 4 plates.</li> <li>The Jurassic Gasteropoda, Part I, No. 4, by Mr. W. H. Hudleston, 5 plates.</li> <li>The Inferior Oolite Ammonites, Part IV, by Mr. S. S. Buckman, 13 plates.</li> <li>The Devonian Fauna of the South of England, Part II, by the Rev. G. F. Whidborne, 12 plates.</li> </ul>
„ XLIV.*	„ 1890	<ul style="list-style-type: none"> <li>The Stromatoporoids, Part III, by Prof. Alleyne Nicholson, 6 plates.</li> <li>The Fossil Echinodermata, Cretaceous, Vol. II, Part I (Asteroidea), by Mr. W. Percy Sladen, 8 plates.</li> <li>The Inferior Oolite Ammonites, Part V, by Mr. S. S. Buckman, 8 plates.</li> <li>The Devonian Fauna of the South of England, Part III, by the Rev. G. F. Whidborne, 9 plates.</li> <li>Title-pages to the Supplement to the Fossil Corals, by Prof. Duncan.</li> </ul>
„ XLV.*	„ 1891	<ul style="list-style-type: none"> <li>The Jurassic Gasteropoda, Part I, No. 5, by Mr. W. H. Hudleston, 4 plates.</li> <li>The Inferior Oolite Ammonites, Part VI, by Mr. S. S. Buckman, 12 plates.</li> <li>The Devonian Fauna of the South of England, Part IV (<i>Conclusion of Vol. I</i>), 7 plates.</li> <li>„ „ Vol. II, Part I, by the Rev. G. F. Whidborne, 5 plates.</li> </ul>
„ XLVI.*	„ 1892	<ul style="list-style-type: none"> <li>The Stromatoporoids, Part IV (<i>Conclusion</i>), by Prof. Alleyne Nicholson, 4 plates.</li> <li>The Palæozoic Phyllopoda, Part II, by Prof. T. R. Jones and Dr. Woodward, 5 plates.</li> <li>The Jurassic Gasteropoda, Part I, No. 6, by Mr. W. H. Hudleston, 6 plates.</li> <li>The Inferior Oolite Ammonites, Part VII, by Mr. S. S. Buckman, 20 plates.</li> <li>The Devonian Fauna of the South of England, Vol. II, Part II, by the Rev. G. F. Whidborne, 5 plates.</li> </ul>
„ XLVII.*	„ 1893	<ul style="list-style-type: none"> <li>The Fossil Sponges, Part III, by Dr. G. J. Hinde, 10 plates.</li> <li>The Fossil Echinodermata, Cretaceous, Vol. II, Part II (Asteroidea), by Mr. W. Percy Sladen, 8 plates.</li> <li>The Inferior Oolite Ammonites, Part VIII, by Mr. S. S. Buckman, 16 plates.</li> <li>The Devonian Fauna of the South of England, Vol. II, Part III, by the Rev. G. F. Whidborne, 7 plates.</li> </ul>
„ XLVIII.*	„ 1894	<ul style="list-style-type: none"> <li>The Jurassic Gasteropoda, Part I, No. 7, by Mr. W. H. Hudleston, 6 plates.</li> <li>Carbonicola, Anthracomya, and Naiadites, Part I, by Dr. W. Hind, 11 plates.</li> <li>The Inferior Oolite Ammonites, Part IX, by Mr. S. S. Buckman, 11 plates.</li> <li>The Fishes of the Old Red Sandstone, Part II, No. 1, by Dr. R. H. Traquair, 4 plates.</li> </ul>
„ XLIX.*	„ 1895	<ul style="list-style-type: none"> <li>The Crag Foraminifera, Part II, by Prof. T. R. Jones, 3 plates.</li> <li>The Jurassic Gasteropoda, Part I, No. 8, by Mr. W. H. Hudleston, 8 plates.</li> <li>Carbonicola, Anthracomya, and Naiadites, Part II, by Dr. W. Hind, 9 plates.</li> <li>The Devonian Fauna of the South of England, Vol. II, Part IV, by the Rev. G. F. Whidborne, 7 plates.</li> </ul>
„ L.*	„ 1896	<ul style="list-style-type: none"> <li>The Crag Foraminifera, Part III, by Prof. T. R. Jones.</li> <li>The Jurassic Gasteropoda, Part I, No. 9 (<i>Conclusion</i>), by Mr. W. H. Hudleston, 4 plates.</li> <li>Carbonicola, Anthracomya, and Naiadites, Part III (<i>Conclusion</i>), by Dr. W. Hind, 1 plate.</li> <li>Carboniferous Lamellibranchiata, Part I, by Dr. W. Hind, 4 plates.</li> <li>The Devonian Fauna of the South of England, Vol. III, Part I, by the Rev. G. F. Whidborne, 16 plates.</li> </ul>

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## § II. LIST OF MONOGRAPHS

### Completed, in course of Publication, and in Preparation.

1. MONOGRAPHS which have been COMPLETED, and which may be bound as separate Volumes, with directions for the BINDING:—

- The Morphology and Histology of *Stigmaria ficoides* by Prof. W. C. Williamson. (*Complete with Title-page and Index in the Volume for the year 1886.*)
- The Eocene Flora, Vol. I (Filices), by Mr. J. S. Gardner and Baron Ettingshausen. (*Complete in the Volumes for the years 1879, 1880, and 1882. Title-page, Index, and directions for the binding, will be found in the Volume for 1882.*)
- The Eocene Flora, Vol. II (Gymnospermæ), by Mr. J. S. Gardner. (*Complete in the Volumes for the years 1883, 1884, and 1885. Title-page, Index, and directions for the binding, will be found in the Volume for 1885.*)
- The Carboniferous and Permian Foraminifera (the genus *Fusulina* excepted), by Mr. H. B. Brady. (*Complete in the Volume for the year 1876.*)
- The Stromatoporoids, by Prof. Alleyne Nicholson. (*Complete in the Volumes for the years 1885, 1888, 1890, and 1892. The Title-page, Index, and directions for binding will be found in the Volume for the year 1892.*)
- The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime. (*Complete in the Volumes for the years 1849, 1851, 1852, 1853, and 1854. The Title-page and Index, with corrected explanations of Plates XVII and XVIII, will be found in the Volume for the year 1854.*)
- Supplement to the Tertiary, Cretaceous, Liassic, and Oolitic Corals, by Prof. Martin Duncan. (*Complete in the Volumes for the years 1865, 1866, 1867, 1868, 1869, 1872, and 1890. The Title-page, with directions for binding, will be found in the Volume for the year 1890.*)
- The Polyzoa of the Crag, by Mr. G. Busk. (*Complete with Title-page and Index in the Volume for the year 1857.*)
- The Tertiary Echinodermata, by Professor Forbes. (*Complete with Title-page in the Volume for the year 1852.*)
- The Fossil Cirripedes, by Mr. C. Darwin. (*Complete in the Volumes for the years 1851, 1854, and 1858. The Title-page will be found in the Volume for the year 1854, and the Index in the Volume for the year 1858.*)
- The Post-Tertiary Entomostraca, by Mr. G. S. Brady, the Rev. H. W. Crosskey, and Mr. D. Robertson. (*Complete, with Title-page and Index, in the Volume for the year 1874.*)
- The Tertiary Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year 1855.*)
- Supplement to the Tertiary Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year 1888.*)
- The Cretaceous Entomostraca, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year 1849.*)
- Supplement to the Cretaceous Entomostraca, by Prof. T. Rupert Jones and Dr. G. J. Hinde. (*Complete, with Title-page and Index, in the Volume for the year 1889.*)
- The Carboniferous Entomostraca, Part I (Cypridinadæ and their allies), by Prof. T. Rupert Jones, Mr. J. W. Kirkby, and Prof. G. S. Brady. (*Complete in the volumes for the years 1874 and 1884. The Title-page and Index will be found in the Volume for the year 1884.*)
- The Fossil Estheriæ, by Prof. T. Rupert Jones. (*Complete, with Title-page and Index, in the Volume for the year 1860.*)



- The Trilobites of the Cambrian, Silurian, and Devonian Formations, by Mr. J. W. Salter. (*Complete in the Volumes for the years 1862, 1863, 1864, 1866, and 1883. The Title-page and Index, with directions for the binding, will be found in the Volume for the year 1883.*)
- The Fossil Merostomata, by Dr. H. Woodward. (*Complete in the Volumes for the years 1865, 1868, 1871, 1872, and 1878. The Title-page and Index, with directions for the binding, will be found in the Volume for the year 1878.*)
- The Fossil Brachiopoda (Tertiary, Cretaceous, Oolitic, and Liassic), Vol. I, by Mr. T. Davidson. (*Complete in the Volumes for the years 1850, 1852, 1853, and 1854. The Index will be found in the Volume for the year 1854, and corrected Title-page in that for 1870.*)
- The Fossil Brachiopoda (Permian and Carboniferous), Vol. II, by Mr. T. Davidson. (*Complete in the Volumes for the years 1856, 1857, 1858, 1859, and 1860. The Index will be found in the Volume for the year 1860, and corrected Title-page in that for 1870.*)
- The Fossil Brachiopoda (Devonian and Silurian), Vol. III, by Mr. T. Davidson. (*Complete in the Volumes for the years 1862, 1863, 1865, 1866, 1868, and 1870. The Title-page and Index will be found in the Volume for the year 1870.*)
- The Fossil Brachiopoda, Vol. IV, by Dr. T. Davidson. Supplements: Tertiary, Cretaceous, Jurassic, Triassic, Permian, and Carboniferous. (*Complete in the Volumes for the years 1873, 1876, 1878, 1880, 1881, and 1882. The Title-page and Index, with directions for the binding will be found in the Volume for the year 1882.*)
- The Fossil Brachiopoda, Vol. V, by Dr. T. Davidson. Supplements: Devonian and Silurian. Appendix to Supplements, General Summary, Catalogue and Index of the British Species. (*Complete in the Volumes for the years 1882, 1883, and 1884. The Title-page, with directions for the binding will be found in the Volume for the year 1884.*)
- The Fossil Brachiopoda, Vol. VI, by Dr. T. Davidson and Mr. W. H. Dalton. Bibliography. (*Complete in the Volume for the year 1885.*)
- The Eocene Bivalves, Vol. I, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volumes for the years 1859, 1862, and 1870. The directions for the binding will be found in the Volume for the year 1870.*)
- Supplement to the Eocene Bivalves, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year 1877.*)
- The Eocene Cephalopoda and Univalves, Vol. I, by Mr. F. E. Edwards and Mr. S. V. Wood. (*Complete in the Volumes for the years 1848, 1852, 1854, 1855, 1858, and 1877. The Title-page, Index, and directions for the binding, will be found in the Volume for the year 1877.*)
- The Mollusca of the Crag, Vol. I, Univalves, by Mr. S. V. Wood. (*The Text, Plates, and Index, will be found in the Volume for the year 1847, and the Title-page will be found in the Volume for the year 1855.*)
- The Mollusca of the Crag, Vol. II, Bivalves, by Mr. S. V. Wood. (*Complete in the Volumes for the years 1850, 1853, 1855, 1858, and 1873. The Title-page will be found in the Volume for the year 1873, and the Index will be found in the Volume for the year 1855, and a Note in the Volume for the year 1858.*)
- The Mollusca of the Crag, Vol. III, Supplement, by Mr. S. V. Wood. (*Complete in the Volumes for the years 1871 and 1873. The Title-page and Index will be found in the Volume for the year 1873.*)
- Second Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year 1879.*)
- The Gasteropoda of the Inferior Oolite, by Mr. W. H. Hudleston. (*Complete in the Volumes for the years 1886, 1887, 1889, 1891, 1892, 1894, 1895, and 1896. The Title-page, Index, and directions for the binding will be found in the Volume for the year 1896.*)



- Third Supplement to the Crag Mollusca, by Mr. S. V. Wood. (*Complete, with Title-page and Index, in the Volume for the year 1882.*)
- The Great Oolite Mollusca, by Professor Morris and Dr. Lycett. (*Complete in the Volumes for the years 1850, 1853, and 1854. The Title-page and Index will be found in the Volume for the year 1854.*)
- The Fossil Trigonæ, by Dr. Lycett. (*Complete in the Volumes for the years 1872, 1874, 1875, 1877, and 1879. The directions for the binding will be found in the Volume for the year 1879.*)
- Supplement to the Fossil Trigonæ, by Dr. Lycett. (*Complete in the Volumes for the years 1881 and 1883. The Title-page, Index, with directions for the binding, will be found in the Volume for the year 1883.*)
- Carbonicola, Anthracomya, and Naiadites, by Dr. Wheelton Hind. (*Complete in the Volumes for the years 1894, 1895, and 1896. The Title-page and Index will be found in the Volume for the year 1896.*)
- The Oolitic Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years 1855, 1856, 1857, 1858, and 1878. Title-page, Index, and directions for the binding, will be found in the Volume for the year 1878.*)
- The Oolitic Echinodermata, Vol. II, Asteroidea, by Dr. Wright. (*Complete in the Volumes for the years 1861, 1864, and 1880. Title-page, Index, and directions for the binding, will be found in the Volume for the year 1880.*)
- The Cretaceous Echinodermata, Vol. I, Echinoidea, by Dr. Wright. (*Complete in the Volumes for the years 1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, and 1882. The Title-page and Index, with directions for the binding, will be found in the Volume for the year 1882.*)
- The Cretaceous (Upper) Cephalopoda, by Mr. D. Sharpe. (*Complete in the Volumes for the years 1853, 1854, and 1855, but wants Title-page and Index.*)
- The Lias Ammonites, by Dr. Wright. (*Complete in the Volumes for the years 1878, 1879, 1880, 1881, 1882, 1883, 1884, and 1885. The Title-page and Index, with directions for the binding, will be found in the Volume for the year 1885.*)
- The Fossils of the Permian Formation, by Professor King. (*Complete, with Title-page and Index, in the Volume for the year 1849. Corrected explanations of Plates XXVIII and XXVIII\* will be found in the Volume for the year 1854.*)
- The Reptilia of the London Clay (and of the Bracklesham and other Tertiary Beds), Vol. I, by Professors Owen and Bell. (*Complete in the Volumes for the years 1848, 1849, 1856, and 1864. Directions for the binding, Title-page, and Index, will be found in the Volume for the year 1864.*) Part I of Vol. II, containing *Chelone gigas* (to be found in the Volume for the year 1880), can be added.
- The Reptilia of the Cretaceous Formations, by Prof. Owen. (*Complete in the Volumes for the years 1851, 1857, 1858, 1862, and 1864. Directions for the binding, Title-page, and Index, will be found in the Volume for the year 1864.*)
- The Reptilia of the Wealden and Purbeck Formations, by Professor Owen. (*Complete in the Volumes for the years 1853, 1854, 1855, 1856, 1857, 1858, 1862, and 1864. Directions for the binding, Title-pages, and Index, will be found in the Volume for the year 1864.*)
- The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), by Professor Owen. (*Complete in the Volumes for the years 1871, 1873, 1876, 1878, 1879, and 1888. Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year 1888.*)
- The Reptilia of the Kimmeridge Clay Formation, by Professor Owen. (*Complete in the Volumes for the years 1859, 1860, 1863, and 1888. Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year 1888.*)

- The Reptilia of the Liassic Formations, by Professor Owen. (*Complete in the Volumes for the years 1859, 1860, 1863, 1869, and 1881. Directions for the binding, Title-pages, and Index, will be found in the Volume for the year 1881.*)
- The Reptilia of the Mesozoic Formations, by Professor Owen. (*Complete in the Volumes for the years 1873, 1875, 1877, and 1888. Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year 1888.*)
- The Red Crag Cetacea, by Professor Owen. (*Complete in the Volumes for the years 1869 and 1888. Directions for the binding, Title-page, Preface, and Table of Contents, will be found in the Volume for the year 1888.*)
- The Fossil Mammalia of the Mesozoic Formations, by Professor Owen. (*Complete, with Title-page and Table of Contents, in the Volume for the year 1870.*)
- The Fossil Elephants, by Professor Leith Adams. (*Complete in the Volumes for the years 1877, 1879, and 1881. Directions for the binding, Title-page, and Index will be found in the Volume for the year 1881.*)

## 2. MONOGRAPHS in course of PUBLICATION :\*—

- The Fossil Sponges, by Dr. G. J. Hinde.
- The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady.†
- The Carboniferous Lamellibranchiata, by Dr. Wheelton Hind.
- The Palæozoic Phyllopora, by Prof. T. Rupert Jones and Dr. H. Woodward.
- The Trilobites, by Dr. H. Woodward.
- The Inferior Oolite Ammonites, by Mr. S. S. Buckman.
- The Belemnites, by Professor Phillips.‡
- The Sirenoid and Crossopterygian Ganoids, by Professor Miall.
- The Fishes of the Carboniferous Formation, by Dr. R. H. Traquair.
- The Fishes of the Old Red Sandstone, by Messrs. J. Powrie and E. Ray Lankester, and Professor Traquair.
- The Pleistocene Mammalia, by Messrs. Boyd Dawkins and W. A. Sanford.
- The Fauna of the Devonian Formation of the South of England, by the Rev. G. F. Whidborne.

## 3. MONOGRAPHS which are promised or are in course of PREPARATION :\*—

- The Fossil Cycadeæ, by Mr. A. C. Seward.
- The Graptolites, by Prof. Lapworth.
- The Carboniferous Entomostraca, Part II, by Messrs. T. Rupert Jones and J. W. Kirkby.
- The Wealden, Purbeck, and Jurassic Entomostraca, by Prof. T. Rupert Jones.
- The Upper Cretaceous Lamellibranchiata, by Mr. H. Woods.
- The Cambrian Fossils, by Dr. H. Hicks.
- The Silurian Fish Bed, by Dr. Harley.
- The Fossils of the Budleigh Salterton Pebble Bed, by the Rev. G. F. Whidborne.

\* Members having specimens which might assist the authors in preparing their respective Monographs are requested to communicate in the first instance with the Honorary Secretary.

† Will be finished by Prof. T. Rupert Jones.

‡ Unfinished through the death of the Author, but will be continued by Mr. G. C. Crick.

### § III. Dates of the Issue of the Yearly Volumes of the Palæontographical Society.

Volume	I	for	1847	was	issued	to	the	Members,	March, 1848.
"	II	"	1848	"	"	"	"	"	July, 1849.
"	III	"	1849	"	"	"	"	"	August, 1850.
"	IV	"	1850	"	"	"	"	"	June, 1851.
"	V	"	1851	"	"	"	"	"	June, 1851.
"	VI	"	1852	"	"	"	"	"	August, 1852.
"	VII	"	1853	"	"	"	"	"	December, 1853.
"	VIII	"	1854	"	"	"	"	"	May, 1855.
"	IX	"	1855	"	"	"	"	"	February, 1857.
"	X	"	1856	"	"	"	"	"	April, 1858.
"	XI	"	1857	"	"	"	"	"	November, 1859.
"	XII	"	1858	"	"	"	"	"	March, 1861.
"	XIII	"	1859	"	"	"	"	"	December, 1861.
"	XIV	"	1860	"	"	"	"	"	May, 1863.
"	XV	"	1861	"	"	"	"	"	May, 1863.
"	XVI	"	1862	"	"	"	"	"	August, 1864.
"	XVII	"	1863	"	"	"	"	"	June, 1865.
"	XVIII	"	1864	"	"	"	"	"	April, 1866.
"	XIX	"	1865	"	"	"	"	"	December, 1866.
"	XX	"	1866	"	"	"	"	"	June, 1867.
"	XXI	"	1867	"	"	"	"	"	June, 1868.
"	XXII	"	1868	"	"	"	"	"	February, 1869.
"	XXIII	"	1869	"	"	"	"	"	January, 1870.
"	XXIV	"	1870	"	"	"	"	"	January, 1871.
"	XXV	"	1871	"	"	"	"	"	June, 1872.
"	XXVI	"	1872	"	"	"	"	"	October, 1872.
"	XXVII	"	1873	"	"	"	"	"	February, 1874.
"	XXVIII	"	1874	"	"	"	"	"	July, 1874.
"	XXIX	"	1875	"	"	"	"	"	December, 1875.
"	XXX	"	1876	"	"	"	"	"	December, 1876.
"	XXXI	"	1877	"	"	"	"	"	February, 1877.
"	XXXII	"	1878	"	"	"	"	"	March, 1878.
"	XXXIII	"	1879	"	"	"	"	"	May, 1879.
"	XXXIV	"	1880	"	"	"	"	"	May, 1880.
"	XXXV	"	1881	"	"	"	"	"	May, 1881.
"	XXXVI	"	1882	"	"	"	"	"	June, 1882.
"	XXXVII	"	1883	"	"	"	"	"	October, 1883.
"	XXXVIII	"	1884	"	"	"	"	"	December, 1884.
"	XXXIX	"	1885	"	"	"	"	"	January, 1886.
"	XL	"	1886	"	"	"	"	"	March, 1887.
"	XLI	"	1887	"	"	"	"	"	January, 1888.
"	XLII	"	1888	"	"	"	"	"	March, 1889.
"	XLIII	"	1889	"	"	"	"	"	March, 1890.
"	XLIV	"	1890	"	"	"	"	"	April, 1891.
"	XLV	"	1891	"	"	"	"	"	February, 1892.
"	XLVI	"	1892	"	"	"	"	"	November, 1892.
"	XLVII	"	1893	"	"	"	"	"	December, 1893.
"	XLVIII	"	1894	"	"	"	"	"	November, 1894.
"	XLIX	"	1895	"	"	"	"	"	October, 1895.
"	L	"	1896	"	"	"	"	"	October, 1896.



I. SUBJECT OF MONOGRAPH.	II. Dates of the Years for which the volume containing the Monograph was issued.	III m. Dates of the Years in which the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
The Morphology and Histology of Stigmara froids, by Prof. W. C. Williamson, COMPLETE .....	1886	1887	66	15	91	1
The Eocene Flora, by Mr. J. S. Gardner and Baron Ettingshausen. Vol. I, COMPLETE .....	1879, 1880, 1882	1879, 1880, 1882	87	13	151	23
" " by Mr. J. S. Gardner. Vol. II, COMPLETE .....	1883, 1884, 1885	1883, 1884, 1886	159	27	400	31
The Flora of the Carboniferous Strata, by Mr. E. W. Binney, in course of completion ..	1867, 1870, 1871, 1875	1868, 1871, 1872, 1875	147	24	141	16
The Fossil Sponges, by Dr. G. J. Hinde, in course of completion .....	1886, 1887, 1893	1887, 1888, 1893	254	19	602	106
The Crag Foraminifera, by Messrs. T. Rupert Jones, W. K. Parker, and H. B. Brady, in course of completion .....	1865, 1895, 1896	1866, 1895, 1896	320	7	381	89
The Carboniferous and Permian Foraminifera, by Mr. H. B. Brady, COMPLETE .....	1876	1876	166	12	266	62
The Stromatopora, by Prof. Alleyne Nicholson, COMPLETE .....	1885, 1888, 1890, 1892	1886, 1889, 1891, 1892	237	29	415	44
The Tertiary, Cretaceous, Oolitic, Devonian, and Silurian Corals, by MM. Milne-Edwards and J. Haime, COMPLETE (t) .....	1849, 1851, 1852, 1853, 1854	1850, 1851, 1852, 1853, 1855	406	72	800	319g
Supplement to the Tertiary, Cretaceous, Oolitic, and Liassic Corals, by Prof. Duncan, COMPLETE {	1865, 1866, 1867, 1868, 1869, 1872, 1890	1866, 1867, 1868, 1869, 1870, 1872, 1891	232	49	797	149
The Polyzoa of the Crag, by Mr. G. Busk, COMPLETE .....	1857	1859	145	22	641	122
The Tertiary Echinodermata, by Prof. Forbes, COMPLETE .....	1852	1852	39	4	144	44
The Oolitic Echinodermata, by Dr. Wright. Vol. I, COMPLETE (t) .....	1855, 1856, 1857, 1858, 1878	1857, 1858, 1859, 1861, 1878	491	43	724	1204
" " Vol. II, COMPLETE .....	1861, 1864, 1880	1863, 1866, 1880	207	22	232	35
The Cretaceous Echinodermata, by Dr. Wright. Vol. I, COMPLETE {	1862, 1867, 1869, 1870, 1872, 1873, 1875, 1878, 1881, 1882	1864, 1868, 1870, 1871, 1872, 1874, 1875, 1878, 1881, 1882	390	87	1119	113
" " by Mr. W. Percy Sladen. Vol. II, in course of completion .....	1890, 1893	1891, 1893	66	16	173	19
The Fossil Cirripedes, by Mr. C. Darwin, COMPLETE .....	1851, 1854, 1858a	1851, 1855, 1861	137	7	320	54
The Fossil Merostomata, by Dr. H. Woodward, COMPLETE .....	1865, 1868, 1871, 1872, 1878	1866, 1869, 1872, 1872, 1878	265	36	365	51
The Post-Tertiary Entomostraca, by Mr. G. S. Brady, Rev. H. W. Crosskey, and Mr. D. Robertson, COMPLETE .....	1874	1874	237	16	515	134
The Tertiary Entomostraca, by Prof. Rupert Jones, COMPLETE .....	1855	1857	74	6	233	56
" " and Mr. C. D. Sherborn (Supplement), COMPLETE .....	1888	1889	55	3	134	48
The Cretaceous Entomostraca, by Prof. Rupert Jones, COMPLETE .....	1849	1850	41	7	176	31
" " and Dr. G. J. Hinde (Supplement), COMPLETE .....	1889	1890	78	4	258	46
The Carboniferous Entomostraca, by Prof. Rupert Jones and Messrs. J. W. Kirkby and Prof. G. S. Brady. Part I, COMPLETE .....	1874, 1884	1874, 1884	95	7	374	81
The Fossil Estherinae, by Prof. Rupert Jones, COMPLETE .....	1860	1863	139	5	158	19i
		CARRIED FORWARD...	4533	552	9610	1813

SUBJECT OF MONOGRAPH.						
II. Dates of the Years for which the volume containing the Monograph was issued.	III. <i>ms.</i> Dates of the Years in which the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.	
BROUGHT FORWARD						
1887, 1892	1888, 1892	124	17	226	72	
1862, 1863, 1864, 1866, 1883	1864, 1865, 1866, 1867, 1883	224	31	703	114	
1883, 1884	1883, 1884	86	10	148	31	
1856, 1860	1858, 1863	88	22	215	50	
1850, 1852, 1853, 1854	1851, 1852, 1853, 1855	409	42	1855	160	
1856 <i>d</i> , 1857, 1858, 1859, 1860	1858, 1859, 1861, 1861, 1863	331	59	1909	157	
1862, 1863, 1865, 1866, 1868, 1870	1864, 1865, 1866, 1867, 1869, 1871	528	70	2766	321	
1873, 1876, 1878, 1880, 1881, 1882	1874, 1876, 1878, 1880, 1881, 1882	383	42	1664	215	
1882, 1883, 1884	1882, 1883, 1884	476	21	1135	116	
1885	1886	163	—	—	—	
1872, 1874, 1875, 1877, 1879	1872, 1874, 1875, 1877, 1879	246	41	446	115	
1881, 1883	1881, 1883	19	4	53	9½	
1847, 1855 <i>b</i>	1848, 1857	216	21	581	244	
1850, 1853, 1855, 1858 <i>e</i>	1851, 1853, 1857, 1861	344	31	691	253	
1871, 1873, 1879, 1882	1872, 1874, 1879, 1882	346	19	546	245	
1848, 1852, 1854, 1855, 1858, 1877	1849, 1852, 1855, 1857, 1861, 1877	361	34	625	275	
1859, 1862, 1870	1861, 1864, 1871	182	25	531	194	
1877	1877	24	2	66	30	
1886, 1887, 1888, 1889, 1891, 1892, 1894, 1895, 1896	1887, 1888, 1889, 1890, 1892, 1892, 1894, 1895, 1896	514	44	1295	455	
1850, 1853, 1854	1851, 1853, 1855	282	30	846	419	
1861	1863	129	15	337	194	
1894, 1895, 1896	1894, 1895, 1896	182	21	704	45	
1896	1896	80	2	40	8	
1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894	1887, 1888, 1889, 1890, 1891, 1892, 1892, 1893, 1894	456	104	1137	168	
1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885	1878, 1879, 1880, 1881, 1882, 1883, 1884, 1886	503	91	726	107	
CARRIED FORWARD		11229	1350	28855	5810	



I. SUBJECT OF MONOGRAPH.	II. Dates of the Years for which the volume containing the Monograph was issued.	III. m. Dates of the Years in which the Monograph was published.	IV. No. of Pages of Letterpress in each Monograph.	V. No. of Plates in each Monograph.	VI. No. of Lithographed Figures and of Woodcuts.	VII. No. of Species described in the Text.
The Belemnites, by Prof. Phillips, <i>in course of completion</i> .....		BROUGHT FORWARD...	11229	1350	28855	5810
The Upper Cretaceous Cephalopoda, by Mr. D. Sharpe, COMPLETE.	1863, 1864, 1866, 1868, 1869	1865, 1866, 1867, 1869, 1870	128	36	622	69
The Fossils of the Permian Formation, by Prof. King, COMPLETE	1853, 1854, 1855 1849, 1854e	1853, 1855, 1857 1850, 1855	67	27	319	79
The Fauna of the Devonian Formation, by the Rev. G. F. Whidborne, Vol. I., COMPLETE.	1888, 1889, 1890, 1891	1889, 1890, 1891, 1892	346	32	770	206
" " " " Vol. II., <i>in course of completion</i>	1891, 1892, 1893, 1895	1892, 1892, 1893, 1895	212	24	489	176
" " " " Vol. III.	1896	1896	112	16	343	86
The Sirenoid Ganoids, by Prof. Miall, <i>in course of completion</i> .....	1878	1878	32	6	61	6
The Fishes of the Carboniferous Formation, by Dr. Traquair, <i>in course of completion</i> .....	1877	1877	60	7	58	5
The Fishes of the Old Red Sandstone, by Messrs. J. Powrie, E. Ray Lankester, and Dr. Traquair, <i>in course of completion</i> .....	1867, 1869, 1894	1868, 1870, 1894	90	18	232	22
The Reptilia of the London Clay [and of the Bracklesham and other Tertiary Beds], by Profs. Owen and Bell, Vol. I., COMPLETE†	1848, 1849, 1856f	1849, 1850, 1859	150	58	304	39
" " " " Vol. II, Part I, by Prof. Owen, COMPLETE.	1880	1880	4	2	4	1
The Reptilia of the Cretaceous Formations, by Prof. Owen, COMPLETE†	1851, 1857, 1858, 1862	1851, 1859, 1861, 1864	184	59	519	26
The Reptilia of the Wealden and Purbeck Formations (with Supplements 1, 2, 3), by Prof. Owen, COMPLETE ‡	1853, 1854, 1855, 1856, 1857, 1858, 1862	1853, 1855, 1857, 1858, 1859, 1861, 1864	155	62	251	17
The Reptilia of the Wealden and Purbeck Formations (Supplements 4—9), COMPLETE .....	1871, 1873, 1876, 1878, 1879, 1888n	1872, 1874, 1876, 1878, 1879, 1889	85	21	175	15
The Reptilia of the Kimmeridge Clay Formation, by Prof. Owen, COMPLETE	1859, 1860, 1868, 1888n	1861, 1863, 1869, 1889	16	6	23	4
The Reptilia of the Liassic Formations, by Prof. Owen, COMPLETE	1859,    1860,    1863, 1869, 1881n	1861, 1863, 1865, 1870, 1881	174	50	276	20
The Reptilia of the Mesozoic Formations, by Prof. Owen, COMPLETE	1873, 1875, 1877, 1888n	1874, 1875, 1877	101	24	165	17
The Red Crag Cetacea, by Prof. Owen, COMPLETE	1869, 1888n	1870, 1889	42	5	43	9
The Fossil Elephants, by Prof. Leith Adams, COMPLETE .....	1877, 1879, 1881n	1877, 1879, 1881	265	28	216	3
The Pleistocene Mammalia, by Messrs. W. Boyd Dawkins and W. A. Sanford, <i>in course of completion</i> .....	1864, 1867, 1868, 1871, 1878 1886	1866, 1868, 1869, 1872, 1878, 1887	333	39	340	12
The Mammalia of the Mesozoic Formations, by Prof. Owen, COMPLETE .....	1870	1871	115	4	247	30
		TOTAL .....	14187	1903	31823	6790

*a* Index.  
*b* Title-page to Univalves.  
 Many of the species are described, but not figured.  
*c* Note to Crag Mollusca.  
*d* Contains the Permian.  
*e* Two corrections of Plates.  
*f* Supplement.  
*g* Title-page to the Permian.  
*h* British species only reckoned.  
*i* British species only reckoned.  
*k* A Supplement is now in course of publication.  
*l* Index will be found in 1878 vol.  
*m* Useful for establishing the dates of new species.  
*n* Contains title-pages and directions for binding.  
 || Marked on outside label 'Reptilia oolitic Formations.'  
 † Title-pages and Index will be found in the 1864 Volume.



§ V. STRATIGRAPHICAL TABLE *exhibiting the BRITISH FOSSILS already figured and described in the ANNUAL VOLUMES (1847—1896) of the PALÆONTOGRAPHICAL SOCIETY.*

	P L A N T S.	PROTOZOA.		RADIATA.		ARTICULATA.					
		Sponges.	Foraminifera.	Stromatoporoids and Corals.	Echinodermata.	Cirripedes.	Cypridae, Cytherinae, &c.	Phyllopoda.	Merostomata.	Trilobites.	Malacostracous Crustacea.
Pleistocene .....	...	...	...	...	.....	.....	{ 1874 1888				
Crag .....	...	...	{ 1865 1895 1896 }	1849	1852	{ 1851 1854 }	1888				
Eocene .....	{ 1879 1880 1882 1883 1884 1885 }	...	...	{ 1849 1865 }	1852	{ 1851 1854 }	{ 1855 1888	...	.....	.....	1856
Cretaceous.....	...	...	...	{ 1849 1868 1869 }	{ 1862 1867 1869 1870 1872 1873 1875 1878 1881 1882 1890 1893 }	{ 1851 1854 }	{ 1849 1889	...	.....	.....	1860
Wealden .....	...	...	...	...	.....	.....	...	1860			
Oolitic .....	...	1893	...	{ 1851 1872 }	{ 1855, 1856, 1857, 1858, 1861, 1878, 1890 }	1851	...	1860			
Liassic .....	...	1893	...	{ 1851 1866 1867 }	{ 1855, 1856, 1858, 1861, 1864 }						
Triassic .....	...	...	...	...	1880	.....	...	1860			
Permian ... ..	1849	1849	{ 1849 1876 }	{ 1849 1852 }	1849	.....	1849	1860			
Carboniferous...	{ 1867 1870 1871 1875 1886 }	1887	1876	1852	.....	.....	{ 1874 1884	1860 1887	{ 1872 1878 }	1883, 1884	
Devonian .....	...	1887	...	{ 1853 1885 1888 1890 1892 }	1895	.....	1888	1860	{ 1865 1868 1872 1878 }	1862, 1888	
Silurian. ....	...	{ 1886 1887 }	...	{ 1854 1885 1890 }	.....	...	...	{ 1887 1892	{ 1868 1871 1872 1878 }	{ 1862, 1863 1864, 1866 }	
Cambrian .....	...	{ 1886 1887 }	...	1890	.....	.....	...	1887	.....	1864	

NOTE.—The numbers in the above List refer to the Volumes issued for those Dates.

STRATIGRAPHICAL TABLE *exhibiting the BRITISH FOSSILS already figured and described in the ANNUAL VOLUMES (1847—1896) of the PALÆONTOGRAPHICAL SOCIETY (continued).*

	MOLLUSCA.				VERTEBRATA.		
	Polyzoa.	Brachiopoda.	Monomyaria, Dinomyaria, and Gasteropoda.	Cephalopoda.	Fishes.	Reptiles.	Mammalia.
Pleistocene .....	...	1873	.....	..	...	.....	{ 1864 1867 1868 1871 1877 1878 1879 1881 1886
Crag .....	1857	{ 1852 1873 1879 }	{ 1847, 1850, 1853, 1855, 1871, 1873, 1879, 1882 }	...	...	.....	{ 1869 1881 1888
Eocene .....	...	{ 1852 1873 }	{ 1852, 1854, 1855, 1858, 1859, 1862, 1870, 1877 }	1848	...	1848, 1849, 1856, 1880	
Cretaceous.....	...	{ 1852, 1854, 1873, 1884 }	{ 1872 1875 1877 1879 }	{ 1853 1854 1855 }	...	{ 1851, 1857, 1858, 1862, 1873, 1888 1853, 1854, 1855, 1856, 1857, 1862, 1871, 1873, 1875, 1876, 1878, 1879 }	
Wealden .....	...	... ..	.....	...	...	{ (Purbeck) 1853, 1858 (Kim. Clay), 1859, 1860, 1868, 1873, 1875, 1877, 1888 (Great Oolite) 1875, 1888 }	
Oolitic .....	...	{ 1850, 1852, 1876, 1878, 1884 }	{ 1850, 1853, 1854, 1872, 1874, 1875, 1877, 1879, 1883, 1886, 1887, 1888, 1889, 1891, 1892, 1894, 1895, 1896 }	{ 1850, 1861, 1868, 1869, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1894, 1863, 1864, 1866, 1868, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885 }	...		1870
Liassic .....	...	{ 1850, 1852, 1876, 1878, 1884 }	{ 1874, 1877, 1879, 1883 }	...	...	{ 1859, 1860, 1863, 1869, 1873, 1881 }	
Triassic.....	...	1876, 1878	1879	.....	1878	.....	1870
Permian .....	1849	{ 1849, 1856, 1880 1856, 1857, 1858, 1859, 1860, 1880, 1884 }	1849	1849	1849	1849	
Carboniferous ...	...	{ 1856, 1857, 1858, 1859, 1860, 1880, 1884 }	{ 1894, 1895, 1896 }	.....	1877		
Devonian .....	1895	{ 1862, 1863, 1881, 1882, 1884, 1893 }	{ 1890, 1891, 1892, 1893, 1896 }	1889	{ 1867 1869 1894 }		
Silurian.....	...	{ 1865, 1866, 1868, 1870, 1881, 1882, 1883 }					
Cambrian .....							

NOTE.—The numbers in the above List refer to the Volumes issued for those Dates.

§ VI. Extract from the Report of the Council to the Annual General Meeting, 19th June, 1896, giving a Brief History of the Society.

"THE origin of the Society was mainly due to the prior issue of Sowerby's 'Mineral Conchology' of which the first part appeared in June, 1812, and was followed by other parts for over thirty years. The portions of this work were brought out slowly and irregularly, and rarely illustrated more than ten species at one time. During the publication of this contribution to Geological Science an Association was formed (probably in the year 1836) called the "London Clay Club," the members of which were enthusiastic collectors of the shells of the Tertiary deposits in the neighbourhood of the metropolis. At one of the meetings of the Club, about the year 1845, the late Dr. (then Mr.) J. S. Bowerbank suggested that as the 'Mineral Conchology' at its then rate of issue could not possibly depict all the British Fossils within a moderate period, it would be well to have recourse to a new method. A proposal immediately followed that subscriptions should be solicited for a larger and more complete publication. The idea was favorably received, Mr. Sowerby was asked to undertake the copper-plate engraving, and many country geologists were communicated with. In the furtherance of this project Mr. Bowerbank laboured with much zeal and energy, the opinion being that in five-and-twenty years the whole of the British fossils would be figured and described.

On March 23rd, 1847, a meeting was held at the apartments of the Geological Society, Somerset House, with Sir Henry De la Beche in the Chair, when it was resolved that a Society be constituted, the object of which should be "to figure and describe as completely as possible a stratigraphical series of British fossils." The meeting further determined that the Annual Subscription should be One Guinea, that the word "Palæontographical" should be the name, and that the Society should consist of a President, Treasurer, Secretary, and a Council of sixteen members. On that day Sir Henry De la Beche was elected President, Mr. S. V. Wood, Treasurer, and Mr. (afterwards Professor) Morris, Secretary. The members of the first Council were Professor T. Bell, Mr. J. S. Bowerbank, Mr. F. E. Edwards, Sir Philip Egerton, Dr. Hugh Falconer, Dr. W. H. Fitton, Mr. J. W. Flower, Professor Edward Forbes, Mr. S. B. Ibbetson, Mr. (afterwards Sir) Charles Lyell, Professor J. Phillips, Mr. (afterwards Sir) Joseph Prestwich, Mr. D. Sharpe, Mr. James Smith, Mr. N. T. Wetherell, and Mr. Alfred White. Of these one alone survives, viz. Sir Joseph Prestwich.\*

In the May of the same year Mr. Morris sent in his resignation, and Mr. Bowerbank was appointed his successor.

The first Annual Report was read on 23rd March, 1848, when it was stated that 640 names had been forwarded for membership, that 363 subscriptions had been received, and that the first volume, 'The Univalves of the Crag,' by S. V. Wood, was ready for delivery. This book contained the earliest list of members, and showed that 568 persons and 30 libraries had been entered on the list at that date.

On August 14th, 1848, a Report was presented to a special meeting at Swansea (where the British Association was assembled), in which it was mentioned that offers of Monographs

\* Within four days after the reading of the Council Report, Sir Joseph Prestwich, who for some months had been in failing health, passed away at the age of eighty-four.



had been made on the Conchiferæ and Foraminifera of the Crag, the Shells of the London Clay, the Fossil Reptilia of Great Britain, the Crustacea of the London Clay Formation, the Corals of the Secondary Formation, the Shells of the Fresh-water Formation above the Crag, the Tertiary Shells of the Clyde, the Spongiadæ of the Chalk Formation, the Fossils of the Magnesian Limestone Formation, the Belemnites of the British Formations, the Fossil Testacea of the Great Oolite, and the Entomostracous Animals of the Chalk, Gault, and Greensand Formations.

In the second Annual Report, read 23rd March, 1849, there is evidence the Society had become established. The Local Secretaries are spoken of as being forty in number, and the enrolled Members as many as 732. It is added that 615 persons had paid for the first volume, and that the receipts for the year 1848-9 were (irrespective of the balance from the previous year) £690 19s. Each succeeding year realised larger funds, until in 1867 the maximum was reached, when the balance-sheet showed an amount of £908 5s. from subscriptions and £1042 8s. 4d. as a total. In 1864 the late Mr. Beriah Botfield, M.P., left a legacy of £10 10s. to the Society. A similar gift has not been repeated.

At the end of twenty years the subscriptions had produced £14,097 19s. 7d., and the expenditure had amounted to £13,969 17s. 3d. Twenty years later the whole of the subscriptions showed a total of £27,385 15s. 4d., and the expenses £27,140 17s. 6d.; whilst at the close of the forty-ninth financial year the sum of the subscriptions was £33,459 0s. 4d., and the money expended had been £32,549 9s. 8d. It is remarkable that so much money could have been subscribed in the forty-nine years, seeing that the whole of the original members had, with eight exceptions, passed away. Of the latter, four are still subscribers. At present the subscriptions from libraries are exceeding those from private individuals, in the proportion of about twenty-four to twenty-one. This change, so different from what had been the case in the beginning, is mainly due to the fact that of late years strong efforts have been made to secure the accession of the free libraries.

Of the officers of the Society, the Presidents have been five,—Sir Henry De la Beche, from 1847 to 1855; Mr. W. J. Hamilton, from 1856 to 1867; Dr. Bowerbank, from 1868 to 1876; Sir Richard Owen, from 1877 to 1892; and Professor Huxley, from 1893 to 1895. (It is proposed that Dr. Henry Woodward be the sixth President.) The Treasurers have been two,—Mr. S. V. Wood, from 1847 to 1884; and Mr. R. Etheridge, from 1885 to the present time. The Secretaries have been three,—Professor Morris, for two months in 1847; Dr. Bowerbank, from 1847 to 1862; and the Rev. Professor Wiltshire, from 1863 to the present time.

The publications of the Society cover a large area of information, and are illustrated by more than nineteen hundred plates. The contents consist of over fourteen thousand pages, and define six thousand seven hundred species. The first Monograph which was issued was that of the Univalves of the Crag. This was followed by others (generally in parts), which, if taken in the order of publication, treat of the Reptilia of the London Clay, the Eocene Mollusca, the Entomostraca of the Cretaceous Formations, Fossils of the Permian, the Fossil Corals, the Mollusca of the Great Oolite, the Fossil Brachiopoda, the Radiaria of the Tertiaries, the Cephalopoda of the Chalk, the Fossil Balanidæ, the Reptilia of the Wealden, the Tertiary Entomostraca, the Oolitic Echinodermata, the Fossil Crustacea, the Reptilia of the Purbeck Limestones and Kimmeridge Clay, the Trilobites, the Belemnites, the Pleistocene Mammalia, the Crag Foraminifera, the Fossil Merostomata, the Old Red Fishes, the Crag Cetacea, the Cretaceous Echinodermata, the Mammalia of the Mesozoic Strata, the Fossil Trigonidæ, the Post-Tertiary and the Carboniferous Entomostraca, the Carboniferous and Permian Foraminifera, the Carboniferous Ganoid Fishes, the

Lias and Inferior-Oolite Ammonites, the Sirenoid Ganoids, the Eocene Flora, the Fossil Elephants, the Stromatoporoids, the Morphology of *Stigmara Ficoides*, the Fossil Sponges, the Inferior Oolite Gasteropoda, the Palæozoic Phyllopoda, the Cretaceous Starfishes, and the Carbonicolæ.

The list of works is already large, but many years must pass away before the whole of the British Fossils are described, and the intention of the original founders of the Society fulfilled."



THE LATE JAMES SCOTT BOWERBANK, LL.D., F.R.S., &c.







THE

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MDCCCXCVI.





A MONOGRAPH  
OF THE  
FORAMINIFERA OF THE CRAG.

PART III.

CONTAINING  
PAGES ix—xii; 211—314.

BY

PROFESSOR T. RUPERT JONES, F.R.S., F.G.S.,

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FIG.	
23. <i>Polymorphina rugosa</i> , <i>d'Orbigny</i>	274

## CORRECTIONS FOR PART II.

Page vi, line 15 from top, for *Polystomella* (*Nonionina*) *scapha* read *Nonionina scapha*.

„ „ „ 25 „ „ *Dentritina* read *Dendritina*.

„ 93, in foot-note, for p. 21 read p. 96.

„ 108, last line of synonyms, for p. 35 read p. 109.

„ 137, line 15 from top, for fig. 10 read fig. 16.

„ 177, line 9 from bottom of text, for figs. 8 and 9, add note:

In the 'Rivista Ital. Paleont.,' June, 1896, Signor C. Fornasini, having examined the original specimens, states that Costa's fig. 8 is probably either a *Polymorphina* or an incipient *Marginulina*; and that Costa's fig. 9 is a *Glandulina*.

## CORRECTIONS FOR PART III.

Page 221, line 9 from top, for Vignettes read Vignette 1.

„ 226 „ 21 „ Cornu Hammonis should not have been printed in capitals.

„ 229, heading and line 11 from top, for *LINARIS* read *LINEARIS*.

„ 250, line 7 from bottom, in foot-note, for *laxum* read *laxus*.

„ 253 „ 2 „ „ „ after Zelanti, add *Acireale*.

„ 257 „ 2 „ in the text, for *Neapol.* read *Neapel* (without the full stop).

„ 271 „ 5 „ after *BREVIS* add *nov., Jones*.

„ 272 „ 1 after *LINEATA* add *nov., Jones*.

„ 278 „ 17 from top, after Appendix add I, Table, No. 59; and for *Tables* read *Table*.

„ 288 „ 4 „ for *ROTALIDÆ* read *ROTALIIDÆ*.

„ 290 „ 10 „ after *nov.* add *Jones*.

„ „ „ 11 from bottom, for *ROTALINÆ* read *ROTALIINÆ*.

„ 293 „ 6 from top, for *Neapol* read *Neapel*.

„ 306 „ 18 from bottom, after *Selsk.* add *Christiania*.

„ 312 „ 3 from top, for *often* read *sometimes*.

„ „ „ 5 „ delete *blunt*.

„ „ „ 8 „ delete *indefinite*.

„ „ lines 12 and 13 from top, for *the few* read *some of those which*.

„ „ line 13 from top delete (from Sutton and Sudbourn).



1. NODOSARIA AMBIGUA, *Neugeboren*, 1856. Plate VI, fig. 11.

Orthocerata, *Soldani*, 1780. Saggio Oritogr., p. 108, pl. vi, fig. 43, L; and (Hortoceratia) Testaceogr., vol. ii, 1798, Appendix, p. 141, pl. vi, fig. 43, L (fossil).

Orthoceratia *Baculi*, *Soldani*, 1791. Testaceogr., vol. i, part 2, pp. 96, 97, pl. cii, figs. zz<sup>1</sup> and A; and pl. ciii, figs. E, F, G, H, and P?

Orthocera?, *Woodward*, 1833. Geol. Norfolk, p. 60, pl. vi, fig. 24.

NODOSARIA SUBÆQUALIS, *Costa*, 1855. Mem. Accad. Sci. Napoli, vol. ii, p. 140, pl. i, fig. 5.

— AMBIGUA, *Costa*, 1856. Atti Accad. Pontan., vol. vii, fasc. 2, p. 137, pl. xii, figs. 9 a, A, and var. figs. 10 a, A.

— — *Neugeboren*, 1856. Denksch. k. Akad. Wiss. Wien, vol. xii, part 2, p. 71, pl. i, figs. 13—16.

— TEXANA, *Conrad*, 1857. Report U.S. and Mexican Boundary Survey, vol. i, part 2, p. 159, pl. xiv, figs. 4 a, b, c.

— TORNATA, *Schwager*, 1865. Novara-Exped. Geol. Theil, vol. ii, p. 223, pl. v, fig. 51.

— SUBÆQUALIS, *Silvestri*, 1872. Atti Accad. Gioen. Sci. Nat., n. s., vol. vii, p. 91, pl. xi, figs. 260—263.

— MONILIFORMIS, *Ehrenberg*, 1873. Abh. k. Akad. Wiss. Berlin, p. 390, pl. vi, III, fig. 11.

— RADICULA, var. AMBIGUA, *Brady*, 1884. Report 'Challenger,' p. 496, pl. lxii, fig. 3.

— AMBIGUA, *Fornasini*, 1889. Foram. Mioc. S. Rufillo, pl. i, fig. 8; and fig. 9, var. (= *Lingulina rotundata*, d'Orb).

— RADICULA, var. AMBIGUA, *Sherborn and Chapman*, 1889. Journ. Roy. Micr. Soc. for 1889, p. 486, pl. xi, fig. 16.

— AMBIGUA, var. SUBÆQUALIS, *Fornasini*, 1890. Mem. Accad. Sci. Bologna, ser. 4, vol. x, p. 467, pl. o, fig. 5.

— — var. ANNULATA, *Fornasini*, 1890. Ibid., ser. 4, vol. x, p. 467, pl. o, figs. 3, 4, 6, 7.

— — — *Mariani*, 1891. Boll. Soc. Geol. Ital., vol. x, fasc. 2, p. 172, pl. vi, fig. 4.

— RADICULA, var. AMBIGUA, *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. xii, fasc. 4, pp. 601 and 625, pl. v, fig. 8.

— AMBIGUA, *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, p. 207, pl. i, fig. 2 (= *N. subæqualis*, Costa<sup>2</sup>).

— — *De Amicis*, 1895. Naturaliste Sicil., vol. xiv, p. 21.

<sup>1</sup> Fig. zz is probably the same as *Nodosaria clava*, Costa, 'Atti Acc. Pont.', vol. vii, 1856, p. 146, pl. xiii, fig. 7; and fig. A, *N. cylindracea*, Costa, *ibid.*, fig. 6; both closely allied to *N. ambigua*.

<sup>2</sup> For the determination of the species in O. G. Costa's Collection see C. Fornasini's discriminative memoir in the vols. iv and v (1894–5) of the work quoted.

*Characters.*—Our small specimen from the Crag consists of four short, almost equal chambers, broader than long, closely set one on another. Zoologically it is a variety of *N. radicula* (Linné); it has many slight modifications of shape, and is closely allied to other forms belonging to the same group.

Among the figured forms we find that figs. 9 and 10 of E. Dervieux's pl. v are also referred to *ambigua* at p. 625. *Nodosaria De-Amicis*, Derv., on the same plate, figs. 63, 63 *bis*, though larger, papillose, and mouth-tubed, is *specifically* the same.

In the numerous figures given by Soldani, rough as they are, much of interest is shown among the many varieties of *N. radicula* of this sub-type "*ambigua*." In the fig. L (pl. vi) referred to above, after the large ovoid primordial segment, the four succeeding chambers are short, equal, and closely set. The fig. zz (pl. cii) has also a large primordial segment; the later chambers are shorter than broad as in *ambigua*, but are irregular in size and direction of growth. Fig. A (pl. cii) has very short and closely-set chambers; it is much larger than fig. L (pl. vi), and somewhat sinuous in its line of growth. Figs. F, G, H (pl. ciii), also have short close-set chambers; and fig. K combines this feature with that of an obliquely striated *Dentalina*, having put on the chambers of the *radicula* type in later life.

The individual, fig. 4c (*Nodosaria radicula*, parte), in pl. ii, of G. Terrigi's memoir in the 'Mem. Descr. Cart. geol. d' Italia,' vol. iv, part i, 1891, is the same as *N. ambigua*.

*Occurrence.*—This variety of *N. radicula* lives in the Mediterranean (Soldani), and at 129 fathoms off the Ki Islands ('Challenger'). It occurs fossil, with other *Nodosariæ*, in several Tertiary formations.

The typical *N. radicula* has a wide geographical range, but it has been most frequently recorded from high latitudes, at depths ranging from 10 to 300 fathoms. Specimens have also been obtained from the North and South Atlantic (1360 and 2350 fathoms), from the South Pacific (37 to 1100 fathoms), from off the Cape of Good Hope (150 fathoms), and from the Adriatic.

Its geological range extends back to the Permian of England and Germany. It has also been met with in the Lias of England, in the Kimmeridge Clay, in the Gault of Folkestone, in the Red Chalk of Speeton, in the Upper Chalk of Taplow, Bucks, and of Keady Hill, Ireland; in the London Clay (Eocene); in the Miocene of Italy, Vienna, and Malaga; and in the Pliocene of Italy, Garrucha (South Spain), and St. Erth. In the Coralline Crag it has been found at Sutton; and at Sudbourne, zone d.

2. NODOSARIA RAPHANUS (*Linné*), 1758. Plate I, figs. 4, 5, 22, 23; Plate VI, figs. 9, 10.

Part I, 1866, page 49; and Appendices I and II, Tables, No. 36.

*Additional Synonyms:*

- Corniculum, *Klein*, 1753. Lucubrat. de Test. format. &c., pp. 28 and 44, tabella,<sup>1</sup> figs. A, B.
- Orthocerata brevissima in longum striata, &c., *Soldani*, 1780. Saggio Oritt., p. 107, pl. v, figs. 40 x X.
- Orthoceratia in longum striata, &c., *Soldani*, 1791. Testaceogr., vol. i, pt. 2, p. 91, pl. xciv, fig. r (long form; *Nodosaria rapa*, d'Orb.); fig. v (*Nod. scalaris*, d'Orb., non Batsch).
- Hortoceratia brevissima in longum striata, &c., *Soldani*, 1798. Testaceogr., vol. ii, Appendix, p. 141, pl. v, figs. 40 x X.
- NODOSARIA (NAUTILUS) RAPHANUS, *Bowdich*, 1822. Elem. Conch., pt. 1, p. 17, pl. ii, fig. 9.
- SCALARIS, d'Orb., 1826. Ann. Sci. Nat., vol. vii, p. 253, No. 18 (non Batsch, 1791).
- CLAVA, *Michelotti*, 1841. Mem. Soc. Fisica Ital., vol. xxiii, p. 276, pl. i, figs. 4 a, b.
- PROPINQUA, *Costa*, 1856. Atti Accad. Pontan., vol. vii, pt. 2, p. 151, pl. xiii, fig. 2.
- TURGIDULA, *Idem*, 1856. Ibid., p. 152, pl. xiii, figs. 3 a, C.
- CONTRACTA, *Idem*, 1857. Mem. Accad. Sci. Napoli, vol. ii, p. 135, pl. i, fig. 3.
- SULCATA, *Idem*, 1857. Ibid., p. 140, pl. i, fig. 4.
- RAPHANUS, *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., ser. 3, vol. iii, p. 477.
- — — 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 453, pl. xix, fig. 10.
- BACTROIDES, *Reuss*, 1863. Sitz. k. Akad. Wiss. Wien, vol. xlvi, p. 37, pl. ii, fig. 5.

<sup>1</sup> This vignette at p. 44 is not numbered. It contains another figure of *N. raphanus* (long var.); and a very long delicate *Nodosaria radricula* (with 23 segments). Among the small figures in the top row, the first and second, and the sixth, appear to be *Rotalia Beccarii*. A and B were in stone from "Gedanum" (Dantzic); all the others probably from Rimini, see p. 10.



## FORAMINIFERA OF THE CRAG.

- NODOSARIA LAMELLOSO-COSTATA, *Reuss*, 1863. *Ibid.*, p. 38, pl. ii, fig. 6.
- PRISMATICA, *Reuss*, 1863. *Ibid.*, p. 36, pl. ii, fig. 7.
- NODOSARINA (NODOSARIA) RAPHANUS, *J. and P.*, 1864. *Geologist*, vol. viii, p. 88.
- NODOSARIA RAPHANUS, *P. and J.*, 1865. *Phil. Trans.*, vol. clv, p. 340, pl. xvi, fig. 1.
- — — *J., P., and B.*, 1866. *Monogr. Foram. Crag*, p. 49, pl. i, figs. 4, 5, 22, 23.
- — — *Brady*, 1867. *Proceed. Somerset Arch. N. H. Soc.*, vol. xiii, p. 222, pl. i, fig. 6.
- — — *P., J., and B.*, 1871. *Ann. Mag. Nat. Hist.*, ser. 4, vol. viii, p. 156, pl. ix, figs. 39, 40.
- — — *Silvestri*, 1872. *Atti Accad. Gioenia Sci. Nat.*, n. s., vol. vii, p. 43, pl. iv, figs. 67—81.
- OBSCURA, *Reuss*, 1874. *Palæontographica*, vol. xx, pt. 2, p. 81, pl. xx, figs. 1—4.
- DENTALINA DEMISSA, *Terquem and Berthelin*, 1875. *Mém. Soc. Géol. France*, ser. 2, vol. x, *Mém. No. 3*, p. 28, pl. ii (xii), figs. 10 a—g.
- NODOSARIA RAPHANUS, *Blake*, 1876. *Yorkshire Lias*, p. 456, pl. xviii, figs. 14, 14 a.
- DENTALINA BURGUNDIE, *Idem*, 1876. *Ibid.*, p. 461, pl. xviii, fig. 29.
- NODOSARIA RADICULA, var. RAPHANUS, *Goës*, 1882. *K. Svensk. Vet.-Akad. Handl.*, vol. xix, No. 4, p. 20, pl. i, figs. 9, 10.
- RAPHANUS, *Terrigi*, 1883. *Atti Accad. Pont. N. Linc.*, vol. xxxv, p. 172, pl. ii, fig. 5.
- — — *Brady*, 1884. *Report 'Challenger'*, p. 512, pl. lxiv, figs. 6—10.
- — — *Balkwill and Wright*, 1885. *Trans. Roy. Irish Acad.*, vol. xxviii (Sci.), p. 342, pl. xii, fig. 26.
- — — and var., *Sherborn and Chapman*, 1886. *Journ. Roy. Microsc. Soc.*, ser. 2, vol. vi, p. 749, pl. xiv, figs. 36, 37.
- — — *Brady*, 1887. *Journ. Roy. Microsc. Soc. for 1887*, p. 909.
- — — *Fornasini*, 1887. *Boll. Soc. Geol. Ital.*, vol. vi, p. 41.
- — — *Idem*, 1890. *Mem. Roy. Accad. Sci. Istit. Bologna*, ser. 4, vol. x, p. 470, pl. o, figs. 24, 25.
- SCALARIS, *Hæusler*, 1890. *Abhandl. Schweiz. Paläont. Ges.*, vol. xvii, p. 101, pl. xiii, fig. 91.
- MULTICOSTA, *Idem*, 1890. *Ibid.*, p. 102, pl. xiii, fig. 92.
- RAPHANUS, *Terrigi*, 1891. *Mem. R. Com. Geol. Ital.*, vol. iv, p. 82, pl. ii, fig. 16.
- — — *De Amicis*, 1893. *Boll. Soc. Geol. Ital.*, vol. xii, fasc. 3, p. 380.
- — — *Dervieux*, 1894. *Boll. Soc. Geol. Ital.*, vol. xii, fasc. 4, pp. 621 and 626, pl. v, figs. 56—59 (figs. 56, 57, and 58 are marginuline).

- NODOSARIA RAPHANUS, *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, pp. 204, 205, pl. i, figs. 41—45 (= *N. inflata* and *abbreviata*, Costa).  
 — — — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 29 and 61.

*Characters*.—Subcylindrical and tapering, varying from fusiform to club-shaped; longitudinally ribbed, the number and strength of the costæ variable.

Three varieties from the Crag are here illustrated:

1. Pl. I, figs. 4, 5; typical for such as Linné named from the figures given by Plancus and Gualtieri; with many ribs (15—16).

2. Pl. I, figs. 22, 23; short and thick, with few ribs (9—10). This form corresponds with fig. 86 of Silvestri's pl. iv, *Nodosaria acuticostata*.

3. Pl. VI, figs. 9, 10; short, thick, and neatly compact form (about 15 to 16 ribs). Fornasini's *Nod. Bassanii*, 'Mem. R. Accad. Sci. Bologna,' ser. 5, vol. iv, 1894, pp. 205, 206, pl. i, figs. 38—40, is near this variety, but has fewer ribs.<sup>1</sup>

Gradations and varieties of *N. raphanus* are shown under the name "*Dentalina propinqua*, Beissel," 1891, in the 'Abhandl. K. Preus. Geol. Landesanst.,' n. s., pt. iii, p. 35, pl. vii, figs. 14—27.

NOTE.—As it is almost impossible to sort all the figured specimens allied to *N. raphanus* and coming within its varietal range, the foregoing synonymy must be understood as indicating some of the best marked and most distinguishable of the forms.

(There are also marginuline forms of the same type, which will be noticed under *Marginulina*.)

*Occurrence*.—*Nodosaria raphanus* is rather common in the Mediterranean and Adriatic at depths ranging to 1100 fathoms. The tables appended to the 'Challenger' report record its presence in soundings from off Culebra Island, Danish West Indies (390 fathoms); and from a depth of 1375 fathoms near Juan Fernandez. Its geological range extends from the Lias. It has also been recorded from the Chalk of Bohemia, Westphalia, and Keady Hill, Ireland; from the London Clay (Eocene); the Miocene of Malaga, Vienna, and Muddy Creek, Victoria; and the Pliocene of Italy. In the Coralline Crag it has been met with at Sudbourne and Broom Hill, zone d; and at Sutton. It has also been found in the Norwich Crag (Thorpe).

<sup>1</sup> In F. Sellheim's "Beitrag zur Foraminiferen-Kenntniss der fränkischen Juraformation," Inaugural Dissertation, &c., Erlangen, 1893, the *Dentalina*, sp. aff. *lamellosa*, Torq., page 12 (of sep. copy), pl. o, fig. 3, seems near enough for *Nodosaria raphanus*; and *N. duodecim-costata*, fig. 2, is not far removed; fig. 4 might be *N. raphanistrum*.

3. NODOSARIA RAPHANISTRUM (*Linné*). Plate I, figs. 6—8.

Part I, 1866, page 50; and Appendices I and II, Tables, No. 37.

*Additional Synonyms:*

- Orthocerata seu tubuli concamerati, recti, &c., *Soldani*, 1780. Sagg. Oritt., p. 106, pl. v, figs. m M, o O; and Testaceogr., vol. ii, 1798, Appendix, p. 141, pl. v, figs. m M, o O.
- in longum striata, subconica, &c., *Soldani*, 1791. Testac., vol. i, part 2, p. 91, pl. xciv, fig. Z (few ribs).
- NODOSARIA BACILLUM, *Blainville*, 1825. Malacol. (plates 1827), pl. v, fig. 4.
- — *Cuvier*, 1836—1846. Regne anim., vol. ix (and x), p. 35, pl. xv, fig. 12.
- FILIFORMIS, *Henderson*, 1837. Cuvier's Animal Kingdom, vol. iii (plates), pl. viii, fig. 10.
- RAPHANISTRUM, *Reuss*, 1846. In Geinitz's Grundriss Verst., p. 653, pl. xxiv, fig. 6.
- COMPRESSIUSCULA, *Neugeboren*, 1852. Verh. Mitth. Siebenburg. Ver. Nat., vol. ii, p. 59, pl. i, figs. 54—56; vol. iii, p. 79.
- RAPHANISTRUM, *Bronn*, 1856. Lethæa Geogn., ed. 3, p. 241, pl. xxv 3, figs. 2 a—d.
- COMPRESSIUSCULA, *Neugeboren*, 1856. Denkschr. k. Akad. Wiss. Wien, vol. xii, p. 79, pl. ii, figs. 1—7.
- BACILLUM, *Costa*, 1857. Mem. Accad. Sci. Napoli, vol. ii, p. 134, pl. i, figs. 7 a—c.
- — *Bronn*, 1859. Klassen, &c., p. 72, pl. vi, figs. 14 a—e.
- — *Mackie*, 1859. Recreative Science, vol. i, p. 148, fig. 18.
- BADENENSIS (part), *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 457, pl. xix, fig. 9.
- RAPHANUS, *Idem*, 1860. Ibid., fig. 10.
- BACILLUM, *Suess*, 1862. Boden Stadt Wien, p. 45, fig. 1 1.
- NODOSARINA (NODOSARIA) RAPHANISTRUM, *J. and P.*, 1864. Geologist, vol. vii, p. 88.
- NODOSARIA RAPHANISTRUM, *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 50, pl. i, figs. 6—8.
- *Brady*, 1867. Proc. Somerset Arch. Nat. Hist. Soc., vol. xiii, p. 222, pl. i, fig. 7.



- NODOSARIA BACILLUM, *Gümbel*, 1870. Abhandl. k. Bayer. Akad. Wiss., vol. x, p. 618, pl. i, fig. 30. The following, also shown in the same plate, are either members or varieties of the same species:—*subalpina*, G., fig. 26; *pachycephala*, G., fig. 27; *eocæna*, G., fig. 28; *Helli*, G., fig. 29; *Maximilliana*, G., fig. 31; *latejugata*, G., fig. 32; *sceptri-formis*, G., fig. 33.
- RAPHANISTRUM, *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 156, pl. ix, fig. 41.
- — *Silvestri*, 1872. Accad. Gioenia Sci. Nat., n. s., vol. vii, p. 27, pl. i, figs. 1—19 (including young and small forms); and var. *MONSTRUOSA*, *ibid.*, pl. i, figs. 20—25, and pl. ii, figs. 26—29 (chiefly the megalospheric or "A" form); and var. *coarctata*, pl. ii, figs. 30—47, and pl. iii, figs. 48—50 (locally constricted individuals).
- BACILLUM, *Schlumberger*, 1874. Compt. Rendu Assoc. France for 1872, p. 562, figs. 14, 15.
- RAPHANISTRUM, *Blake*, 1876. Yorkshire Lias, p. 457, pl. xviii, figs. 18, 18a.
- — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, pl. o, fig. 3.
- LATEJUGATA, *Hantken* (1875), 1881. Mitth. Jahrb. Ung. Geol. Anstalt, vol. iv, p. 26, pl. ii, figs. 6a—d.
- BACILLOIDES, *Idem* (1875), 1881. *Ibid.*, p. 27, pl. ii, fig. 8 (short).
- BACILLUM, var. *MINOR*, *Idem* (1875), 1881. *Ibid.*, p. 26, pl. ii, fig. 7.
- BUDENSIS, *Idem* (1875), 1881. *Ibid.*, p. 28, pl. ii, fig. 10.
- — *Jones*, 1876. M. Microsc. Journ., vol. xv, pl. cxxix, figs. 8a, b.
- BACILLUM, *Bütschli*, 1880. Bronn's Klassen, &c., p. 197, pl. viii, fig. 14.
- — *Schlumberger*, 1882. Feuil. Jeun. Nat., part 1, pl. i, fig. 5; and pl. ii, fig. 5.
- RAPHANISTRUM, *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 422, fig. 266, 8.
- — *Koenen*, 1885. Abhandl. k. Ges. Wiss. Göttingen, vol. xxxii, p. 110, pl. v, figs. 16—20.
- — *Quenstedt*, 1885. Handb. Petref., ed. 3, part 5, p. 1050, pl. lxxxvi, figs. 4, 5.
- AFFINIS, *Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 748, pl. xiv, fig. 33.
- BACILLUM, *Idem*, 1886. *Ibid.*, p. 748, pl. xiv, fig. 34.

- NODOSARIA RAPHANISTRUM, var., *Idem*, 1886. Ibid., p. 749, pl. xiv, fig. 38.  
 — POLYGONA, *Idem*, 1886. Ibid., p. 749, pl. xv, figs. 2—4.  
 — RAPHANISTRUM, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 146, 147, 148, 193, 194.  
 — — *Haeusler*, 1890. Abhandl. Schweiz. Pal. Ges., vol. xvii, p. 101, pl. xiii, figs. 82—85, 89, 96 (with few ribs; fragments and young).  
 — — *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, pp. 203 and 205, pl. i, figs. 50, 51 (= *N. deiscens* and *bacillum*, Costa).  
 — — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 30 and 61.

*Characters.*—This, when in good condition, is the longest, straightest, and most symmetrical of the costate *Nodosariæ*. Shorter forms approach, and indeed pass into *N. raphanus*, becoming broader in some parts of the shell than in others. Many individuals commenced growth with a large primordial segment (*megalospheric* or form “A”—see above, p. 90); and others with a small beginning (*microspheric*, or form “B”) have the shell tapering backwards or downwards to a point. These features, as well as irregularities of growth, have influenced the giving of names to a great extent. When the shell has grown with a curvature it becomes a *Dentalina*; when the excentricity brings the stolon more to one side than the other, the form becomes a *Vaginulina* or *Marginalina*, and when extreme leads to *Cristellaria*.<sup>1</sup>

Gradational varieties of *N. raphanistrum* are well shown under the name “*Dentalina acuta*, d’Orb.,” and “*D. polyphragma*, Reuss,” in ‘Abhandl. K. Preuss. Geol. Landesanst.,’ n. s., part iii, 1891, pp. 37, 38, pl. vii, figs. 28—65.

*Occurrence.*—*Nodosaria raphanistrum* is of very rare occurrence in recent seas. It has been found in the Mediterranean and Adriatic. Fossil specimens have been recorded from the Lias of Yorkshire and elsewhere, the Oxford and Kimmeridge Clays; and there are corresponding forms, such as *Nod. Zippei*, &c., in the Chalk of England, Westphalia, and Bohemia. *N. raphanistrum* is also known in the Eocene (London Clay and Thanet Sands<sup>2</sup>); the Miocene of Vienna, Italy, Malaga, Malta, and San Domingo; also in the Pliocene of Italy, and of Auckland, New Zealand. In the Coralline Crag it has been found at Sutton only.

<sup>1</sup> This subject has often been treated of; for instance, in the ‘Monthly Microsc. Journ.,’ vol. xv, 1876, p. 76.

<sup>2</sup> Mentioned in the ‘Mem. Geol. Survey Gt. Brit.,’ vol. iv, 1872, p. 575, but it is doubtful. The allocation of this species, together with a *Planorbulina* and a *Polymorphina*, to the Woolwich and Reading beds, at p. 578, is a mistake.

4. NODOSARIA PROXIMA, *Silvestri*, 1872. Plate IV, fig. 8 (“*N. scalaris*”); Plate VII, fig. 15.

Part I, 1866, page 52 (*N. scalaris*); and Append. I and II, Tables, No. 38.

- NODOSARIA CATESBYI, *d'Orb.*, 1839. Foram. Cuba, p. 16, pl. i, figs. 8—10.  
 — SCALARIS,<sup>1</sup> *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 52, pl. iv, fig. 8.  
 — (D.) CRASSA, *Hantken*, 1868. Magyar földt társ. munk., vol. iv, p. 86, pl. i, fig. 15.  
 — BACILLOIDES, *Idem*, 1868. Ibid., p. 86, pl. i, figs. 9 *a—c*.  
 — PROXIMA, *Silvestri*, 1872. Atti Accad. Gioenia Sci. Nat., n. s., vol. vii, p. 63, pl. vi, figs. 138—147.  
 — VARIABILIS (?), *Terquem and Berthelin*, 1875. Mém. Soc. Géol. France, ser. 2, vol. x, Mém. No. 3, p. 20, pl. i (xi), figs. 19 *a—f*.  
 — CRASSA, *Hantken*, 1875 (1881). Mitth. Jahrb. K. Ungar, geol. Ges., vol. iv, p. 28, pl. xiii, fig. 4.  
 — BACILLOIDES, *Idem*, 1875 (1881). Ibid., p. 27, pl. ii, fig. 8.  
 — PROXIMA, *Brady*, 1884. Report “Challenger,” p. 511, pl. lxiv, fig. 15.  
 — — *Fornasini*, 1888. Boll. Soc. Geol. Ital., vol. vii, p. 48, pl. iii, figs. 10, 11 (somewhat marginuline).  
 — MUTABILIS, *Crick and Sherb.*, 1891. Journ. Northampton Nat. Hist. Soc., vol. vi, p. 214, pl. vi, figs. 7, 8.  
 — PROXIMA, *Terrigi*, 1891. Mem. Comitato Geol. Ital., vol. iv, p. 82, pl. ii, fig. 17.  
 — — *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, p. 206, pl. i, figs. 33—35 (= *N. trilocularis*, Costa).

These two small Nodosarians from the Crag, bilocular and ribbed, having the suture well marked and a projecting mouth-piece, are nearly matched with either the small young or arrested forms of *Nodosaria longicauda*, *d'Orb.*, in *Silvestri's* memoir referred to above, p. 58, pl. v, figs. 107, 108, and 118, and var., pl. vi, figs. 133, 134, or, with the small forms, figs. 138—147, which he has named *N. proxima*, p. 63. The latter are the nearest to ours, inasmuch as the second segment is smaller and more tapering than the first. The latter feature, namely, the delicate lagenoid second chamber, is emphasised in *N. pupoides*, *Silv.*, p. 65, pl. vi, figs. 148—158. Indeed, all the three so-called “species” (*longicauda*, *proxima*,

<sup>1</sup> In the list of synonyms at pp. 52, 53, the names *Nodosaria inflata*, *Reuss*, *Dentalina inflata*, *Reuss*, and *Nodosaria nana*, *Reuss*, should not have been inserted as belonging to the real *N. scalaris*.



and *pupoides*) are essentially the same, differing but slightly in contour and style of growth. Of the three, the little specimens from the Crag best agree with the *proxima* form.

Pl. vii, fig. 15 (Gedgrave), has the sutures shallower and the riblets smaller than pl. iv, fig. 8 (Bridlington). Brady's figure of *N. proxima* has the two chambers nearly equal in size, with a deep suture, and he was somewhat inclined to refer it to *N. scalaris* (Batsch). The number of ribs varied in the specimens collected by the 'Challenger.'

Some bilocular costate *Lagenæ* (simulating *N. proxima*) have been figured by Parker and Jones, Wallich, O. Rymer Jones, &c.; they have the second or super-added chamber larger than the first, corresponding in some degree to the beginning of microspheric *Nodosariæ*.

Throughout the series from the Crag there is considerable variation in both the depth of suture and number of riblets.

*Occurrence.*—*Nodosaria proxima* in recent seas appears to be confined to tropical and subtropical latitudes. Specimens were obtained by the 'Challenger' from off the Azores (450 fathoms); off Tristan d'Acunha (100 to 150 fathoms), of Raine Island, Torres Strait (155 fathoms); off the Phillipines (95 fathoms), and off the coral reef of Honolulu (40 fathoms). The shell figured in 'Phil. Trans.,' vol. clv, 1865, pl. xvi, fig. 2, from the North Atlantic, under the name of *N. scalaris*, is probably referrible to this species.

Fossil specimens have been obtained from the Pliocene of San Quirico, near Sienna (Silvestri), and of Ponticello, near Bologna (Fornasini). We have in our own collections numerous specimens from the Miocene of Muddy Creek, and from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag it occurs in nearly every zone examined.

### *Genus*<sup>1</sup> 3.—DENTALINA, *d'Orbigny*, 1826.

Part 1, 1866, p. 53.

This subgeneric (or, indeed, only *quasi*-subgeneric) form of *Nodosaria* has been so often referred to by writers on Foraminifera, both separately and under the name of *Nodosaria*, that it appears to be useless to endeavour to disentangle the reference further than as suggested at page 53 of Part I. So that besides indicating *Nodosarina* as having been used as a comprehensive generic term by Parker, Jones, Goës, and a few other authors, we need only add to each of the lists there given, under "Nodosaria" and "Dentalina," the words "and others."

<sup>1</sup> *Quasi*-generic only.

To do away with the term "*Dentalina*" would be very inconvenient, and, indeed, an unnecessary sacrifice to an attempted exactness in terminology; for its use is certainly convenient in the frequent mention and defining of the arcuate and tapering *Nodosaria*s to which it has been so long applied, whether by itself, or inserted in brackets after "*Nodosaria*."

1. DENTALINA OBLIQUA (*Linné*), 1767. Plate I, fig. 9; Plate V, fig. 6.

Part I, 1866, p. 54; and Append. I and II, Tables, No. 42.

*Additional Synonyms:*

*Orthoceras*, *Martini*, 1769. N. Syst. Conch.-Cab., vol. i, pp. i and 39, Vignettes, *H, h*.

*Orthocerata conico-cylindroidea*, *recurva*, *striata*, &c., *Soldani*, 1780. Saggio Oritto-graphia, p. 107, pl. v, figs. 37 p P; *Hortoceratia*, &c., *Testaceogr.*, vol. ii, Appendix, 1798, p. 141, pl. v, figs. 37 p P [an arcuate, tapering form of *N. raphanus*].

*Orthoceratia in longum striata*, *subconica*, &c., *Soldani*, 1791. *Testaceogr.*, vol. i, part 2, p. 91, pl. xciv, fig. 8 (= *Nodosaria* [*Dentalina*] *substriata*, d'Orb. *Ann. Sci. Nat.*, vol. vii, 1826, p. 255, No. 46; *Ann. Mag. N. H.*, ser. 4, vol. viii, 1871, p. 160, No. 27, pl. ix, fig. 54.) A tapering form, with short chambers, imperfectly costate.

— *Baculi*, I, K, L, ostendunt aliquas *Raphani* vel *Raphanistri* varietates, *Soldani*, 1791. *Ibid.*, p. 97, pl. ciii. [Fig. I (= *Nodosaria* [*Dentalina*] *Cuvieri*, d'Orb., vol. vii, 1826, p. 255, No. 45; *Ann. Mag. N. Hist.*, ser. 4, vol. viii, 1871, p. 160, No. 26, pl. ix, fig. 57.) Curved, conico-cylindroid, tapering; except near the top the septa are not excavate. In fig. K the lower half is *D. obliqua*, but the upper part takes on smooth and short chambers, like those in *N. ambigua*. In fig. L the lower part is *D. obliqua*, but the upper and larger moiety has only short, scattered, irregular riblets.

- Orthoceras corniculum*, &c., *Soldani*, 1791. *Ibid.*, p. 98, pl. ciii, fig. *k* (= *N. [D.] cornicula* [um], d'Orb.,<sup>1</sup> *Ann. Sci. Nat.*, vol. vii, 1826, p. 255, No. 47; *Ann. Mag. N. H.*, ser. 4, vol. viii, 1871, p. 161, No. 28, pl. ix, fig. 56). Strongly curved; thin at first, thicker with swollen chambers afterwards.
- Orthoceratia filiformia aut capillaria*, &c., *Soldani*, 1798. *Testaceogr.*, vol. ii, p. 35, pl. x, figs. *f, g* (= *Nodosaria nodosa*, d'Orbigny, *Ann. Sci. Nat.*, vol. vii, 1826, p. 254, No. 31; *Ann. Mag. N. H.*, ser. 4, vol. viii, 1871, p. 158, No. 17, pl. ix, fig. 55; not *N. nodosa*, d'Orb., *Mém. Soc. géol. France*, vol. iv, part 1, 1840, p. 14, pl. i, figs. 6, 7). A long, slender, tapering form, with suboval chambers.
- DENTALINA BIFURCATA, *Costa*, 1856. *Atti Accad. Pontan.*, vol. vii, fasc. 2, p. 162, pl. xii, fig. 27.
- NODOSARIA MUTABILIS, *Costa*, 1856. *Ibid.*, vol. vii, p. 150, pl. xiii, fig. 1.
- (DENTALINA) OBLIQUA, *Parker and Jones*, 1859. *Ann. Mag. Nat. Hist.* ser. 3, vol. iii, p. 482.
- — — *P., J., and B.*, 1861. *Ibid.*, ser. 3, vol. xvi, p. 19, pl. i, fig. 32.
- DENTALINA OBLIQUA, *J., P., and B.*, 1866. *Monogr. Foram. Crag*, p. 54, pl. i, fig. 9.
- — *Brady*, 1867. *Proc. Somerset Arch. N. H. Soc.*, vol. xiii, p. 224, pl. i, fig. 17.
- RAPA, *Blake*, 1876. *Yorkshire Lias*, p. 460, pl. xix, fig. 3.
- NODOSARIA OBLIQUA, *Brady*, 1884. *Report 'Challenger'*, p. 513, pl. lxiv, figs. 20—22.
- (DENTALINA) OBLIQUA, *Basset*, 1885. *Ann. Soc. Sci. Charente-Inf.* for 1884, p. 160.
- DENTALINA MULTILINEATA (?), *Sherborn and Chapman*, 1886. *Journ. R. Micr. Soc.*, ser. 2, vol. vi, p. 751, pl. xv, fig. 14.
- NODOSARIA OBLIQUA, *Brady*, 1887. *Journ. R. Microsc. Soc.* for 1887, p. 909.
- — *Brady, Parker, and Jones*, 1888. *Trans. Zool. Soc.*, vol. xii, part 7, p. 223, pl. xlv, fig. 7.
- DENTALINA SULCATA, *Sherborn and Chapman*, 1889. *Journ. R. Micr. Soc.* for 1889, p. 486, pl. xi, fig. 24.

<sup>1</sup> By changing *corniculum* into *cornicula* d'Orbigny made a *little crow* out of a *little horn*, which latter the shell resembles.



- NODOSARIA OBLIQUA, *Fornasini*, 1892. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. ii, p. 564, pl. o, figs. 1—3 (forma A); figs. 4, 5 (forma B); fig. 6, var. ? (forma A); fig. 7, var. *vertebralis*, Batsch (forma A). Ibid., vol. iii, 1893, p. 434, pl. ii, fig. 5; vol. iv, 1894, pp. 203, 204, 209, 213, pl. i, figs. 46—49; pl. ii, figs. 7—9 (*D.* and *N. mutabilis* and *N. siphunculoides*, Costa).
- — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 387 (long synonymy).
- — *Dervieux*, 1894. Ibid., vol. xii, fasc. 4, p. 626, pl. v, fig. 62.
- VERTEBRALIS (?), *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 344, pl. xi, fig. 36.
- OBLIQUA, *Goës*, 1894. K. Vet.-Akad. Handl., vol. xxv, No. 9, p. 70, pl. xii, figs. 691—696.

*Characters*.—This is an elongate, acuminate, and arcuate modification of *Nodosaria raphanus*, and to avoid repetitive terminology the word *Nodosaria* is here omitted before *Dentalina*, as intimated above at pages 206 and 220. This is not the smooth *D. obliqua* of d'Orbigny; see 'Ann. Mag. Nat. Hist.,' 1871, p. 159.

The slender, acuminate, and straight (microspheric) form of *N. raphanus* (*N. aciculata* of Lamarck) is beautifully illustrated by Silvestri ('Atti Accad. Gioenia Sci. Nat.,' ser. 3, vol. vii, 1872, p. 39, pl. iii, figs. 52—56) as *Nodosaria conica* (thus named by him after Soldani, but not by the latter, for Soldani named nothing according to the Linnæan method).<sup>1</sup>

*Occurrence*.—*Dentalina obliqua* has a wide geographical and bathymetrical range. The tables appended to the 'Challenger' Report record the occurrence of specimens at six stations, namely, off the north-west coast of Ireland, off the west coast of Africa, off the Cape of Good Hope, between Prince Edward Island and Kerguelen, off Sydney, and in the equatorial region of the South Pacific. The depth in these cases ranged from 150 to 2425 fathoms. It occurs also in the Mediterranean and Adriatic. Fossil specimens have been recorded from the Permian (*D. Kingii*), from the Lower Lias (Brady), from the Chalk of Bohemia and of Swanscombe (Kent), from the London Clay (Eocene), the Oligocene of Elsass, the Miocene of Italy, Messina (Sicily), and Muddy Creek (Victoria), from the Pliocene of Italy, and of Garrucha, South Spain. In addition to the record from Sutton given in the First Part of this Monograph, we have specimens from Sutton, zone f, and from Aldborough, zone g.

<sup>1</sup> See 'Ann. Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, p. 153.

2. DENTALINA OBLIQUESTRIATA, *Reuss*. Plate I, fig. 19.

Part I, 1886, p. 56; and Appendices I and II, Tables, No. 40.

*Additional Synonyms:*<sup>1</sup>

- Orthocerata, seu tubuli concamerati, recti, striati, *Soldani*, 1780. Sagg. Oritt., p. 106, pl. v, fig. 37 *N* (?).  
 DENTALINA OBLIQUESTRIATA, *Bronn*, 1856. Lethæa Geogn., ed. 3, vol. iii, p. 240, pl. 35 2, fig. 1.  
 NODOSARIA OBLIQUESTRIATA, *Costa*, 1857. Mem. Accad. Sci. Napoli, vol. ii, pl. i, fig. 24.  
 DENTALINA OBLIQUESTRIATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, p. 56, pl. i, fig. 19.  
 — — — *Blake*, 1876. Yorkshire Lias, p. 460, pl. xix, fig. 4.  
 MARGINULINA BONONIENSIS (?), *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 187, pl. ii, fig. 7 *a, b*.  
 DENTALINA OBLIQUESTRIATA, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 751, pl. xv, fig. 15.

*Characters*.—Tapering and bent; many oblique riblets on each chamber, excepting sometimes the latest.

*Occurrence*.—*Dentalina obliquestriata*, as stated in the First Part of this Monograph, appears not to have been found in a recent condition. No mention of it is made by Brady in the 'Challenger' Report. It has been recorded from the Yorkshire Lias (Tate and Blake); from the London Clay (Sherborn and Chapman); and we have it from the Casterlian of the Kattendyk Docks, Antwerp. So far as the Crag is concerned, we have nothing to add to the record in the First Part of the Monograph.

3. DENTALINA PAUPERATA, *d'Orbigny*, 1846. Plate I, figs. 13—18 and 20.

Part I, 1866, pages 59 and 63; and Appendices I and II, Tables, No. 39.

In the First Part of this Monograph, *d'Orbigny's Dentalina pauperata* was taken as a subtypical form to which certain Dentalines might be conveniently referred. Their relationship one to another, and to *D. communis*, *d'Orb.*, was carefully indicated in the nomenclatorial lists at pages 58—62. Names upon names have been given for this kind of smooth, arcuate, tapering, and very

<sup>1</sup> Signor C. Fornasini ('Boll. Soc. Geol. Ital.', ix, 1890, pp. 345—6) points out that in the synonyms "*D. Geintziana*, Terquem," should be changed to "*D. matutina*, Terquem;" and "pl. ii" should be inserted.

variable shell; and it scarcely appears worth while to enlarge the synonymy. Many plates in the works of d'Orbigny, Reuss, Schlicht, Terquem, Neugeboren, Goës, Dervieux, Egger, Beissel, and others, contain legions of named specimens showing modifications of this simple type.

As some of the later illustrations of *Dentalina pauperata* itself, the following may be mentioned.

- DENTALINA COMMUNIS (part), *J., P., and B.*, 1866. Monogr. Foram. Crag, p. 59, pl. i, figs. 13—18, 20.
- PAUPERATA, *Brady*, 1867. Proceed. Somerset Arch. N. H. Soc., vol. xiii, p. 224, pl. i, fig. 14.
- — *Hantken*, 1876 (1881). Magyar kir. földt. int. évkönyve, p. 26, pl. iii, fig. 6; Mitth. Jahrb. Ungar. geol. Anstalt, vol. iv, p. 31, pl. iii, fig. 6.
- — *Blake*, 1876. Yorkshire Lias, p. 458, pl. xviii, fig. 23.
- — *Terrigi*, 1883. Atti Accad. Pont. Nuovi Lincei, vol. xxxv, p. 178, pl. ii, fig. 14.
- NODOSARIA (DENTALINA) PAUPERATA, *Brady*, 1884. Report 'Challenger,' p. 500, cuts, figs. 14 *a, b, c*.
- DENTALINA PAUPERATA, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 750, pl. xv, fig. 9.
- NODOSARIA ANNULATA, *Fornasini*, 1889. Foram. Mioc. S. Ruffillo, pl. i, figs. 10—13.
- DENTALINA INCRASSATA, *Beissel (Holzapfel)*, 1891. Abhandl. k. Preuss. Geol. Landesanst., n. s., part 3, p. 35, pl. vii, figs. 10—13.
- NODOSARIA PARONÆ, *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. xii, fasc. 4, p. 611, pl. v, figs. 36, 37.
- PAUPERATA, *Idem*, 1894. Ibid., p. 612, pl. v, fig. 38.
- — VAR. ELONGATA, *Idem*, 1894. Ibid., fig. 39.
- CAMERANI, *Idem*, 1894. Ibid., figs. 40, 41.
- GLOBULOSA, *Idem*, 1894. Ibid., p. 614, pl. v, fig. 44.
- APPROXIMATA, *Idem*, 1894. Ibid., figs. 45, 46.
- PAUPERATA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 68, pl. xii, figs. 672—688.

It may be mentioned that in Soldani's Testaceogr., vol. i, part 2, 1791, p. 98, pl. cv, fig. *M*, referred to by him as "*Orthoceras Cuspis*," is the same as *D. pauperata*, or a sub-variety of *D. farcimen*, Reuss.

*Characters*.—Often irregular in growth, the chambers not being symmetrical in shape and size; the early chambers are generally subcylindrical and compact; sometimes the septa are nearly all obscure.

*Occurrence*.—The typical form, namely, *Dentalina communis*,<sup>1</sup> d'Orb., is found

<sup>1</sup> In 1863 von Reuss ('Bull. Acad. Roy. Belge,' ser. 2, vol. xv, p. 146, pl. i, fig. 18) separated the variety "with straight septal planes" (part 1, 1866, p. 58) from that "with oblique septa,"



in nearly all seas, and at all depths from the shore-line down to 2740 fathoms. It is worthy of note that the distribution tables appended to the 'Challenger' Report record no specimens from the North Pacific.

The shell has been found in a fossil condition in the Carboniferous and Permian Limestones; in the Yorkshire Lias; in the Cretaceous formations generally; in the London Clay (Eocene); in the Miocene of Vienna, Italy, and Malaga; in the Pliocene of Garrucha (South Spain), Italy, and Kar Nicobar; and in Pleistocene deposits generally.

The tables appended to the 'Challenger' Report show a rather restricted geographical range for *Dentalina pauperata*. The records of its occurrence are almost entirely from high latitudes, and from depths ranging from 13 to 245 fathoms. Its earliest recorded occurrence in a fossil condition is from the Lias (Terquem). It has also been found in the Gault of Folkestone; the Upper Chalk of Taplow, Bucks, and Keady Hill, Ireland; the London Clay (Eocene); the Miocene of Piedmont, Vienna, and Muddy Creek, Victoria; and the Pliocene of Piedmont and St. Erth. In the Coralline Crag it has been found at Sutton only.

*Genus 4.*—VAGINULINA, *d'Orbigny*, 1826.

Part I, 1866, page 63.

*Brady, Report 'Challenger,' 1884, p. 529.*

*Additional Synonyms :*

CORNU HAMMONIS, *Plancus*.

Orthoceratia, *Soldani*.

PLANULARIA, *DeFrance, Cornuel*.

VAGINULINA, *Michelotti, Philippi, Costa, Gümbel, Deecke, Fornasini, Dervieux, Goës, Egger, Zwingli and Kübler, Berthelin, Neugeboren, Quenstedt, Koch, Hagenow, Chapman, &c.*

CITHARINA, *d'Orbigny, Reuss, Costa, Schwager*.

MARGINULINA, *Reuss, Terquem*.

DENTALINA, *Williamson, Parker and Jones*.

NODOSARIA, *Reuss*.

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*D. communis* (p. 61), under the name *D. farcimen*, after Soldani's "Orthoc. *Farcimen*," 'Testaceogr.' vol. i, part 2, 1791, p. 98, pl. cv, fig. o. A closely allied variety is Soldani's "*Corniculum læve*," *ibid.*, p. 92, pl. xcvi, fig. bb. As Soldani did not use the Linnaean method of nomenclature, the straight-sutured *Dentalina* is really "*D. farcimen* of Reuss." Further, Soldani applied the term "*farcimen*" to more than one of his figured specimens (see 'Annals Mag. Nat. Hist.,' ser. 4, vol. viii, 1871, p. 154, No. 2; and p. 159, No. 20; also *ibid.*, p. 153): if individual names were taken for species from his books (and there they seem sometimes to have been used as much generically as otherwise) much confusion would arise in the alteration of numerous trivial names.

*General Characters.*—*Vaginulina* is an elongate, more or less compressed or complanate Nodosarine, with eccentric (marginal) aperture and oblique chambers; straight or curved; septate or compact; smooth, limbate, or costate.

Linné adopted the figures published by Plancus, Gualtieri, and Ledermüller for his *Nautilus legumen*.<sup>1</sup> The figure given by Gualtieri is decidedly limbate; but those by Plancus and Ledermüller, although apparently limbate, may be smooth (as regarded by Signor Fornasini), with the septa marked only by a difference in the shell-structure, as more clearly shown in Brady's figures in the 'Challenger' Report. Doubtless both the limbate and the smooth forms come together under the same species zoologically, but their readily distinguished features make it convenient to retain distinct names for them. Their relationship was indicated in the tabular list at pages 64—66 in Part I; the smooth forms being variety  $\alpha$ , var.  $\beta$ , and var.  $\eta$ ; the limbate forms (*V. legumen* proper) being comprised in varieties  $\gamma$ ,  $\delta$ ,  $\epsilon$ ,  $\zeta$ ,  $\theta$ ,  $\iota$ ,  $\kappa$ .

The trivial circumstance of the *quasi*-smooth figure given by Plancus being the first mentioned by Linné in his references (possibly because his was the oldest book) does not keep us from accepting the *limbate* form (Gualtieri's) as this best medium type (according to the plan followed by Parker and Jones), around which the weak and smooth (*V. lævigata*, &c.) on one hand, and the more ornamented forms (*V. linearis*, &c.) on the other, are taken as noticeable varieties; as in the classificatory lists above referred to.

This species (including the forms figured by Plancus and Gualtieri) is referred to by Parker and Jones in the 'Annals Mag. Nat. Hist.,' ser. 3, vol. iii, 1859, p. 479. See also C. Fornasini's remarks on the limbate form in the 'Bollet. Soc. Geol. Ital.,' vol. v, pp. 25—30, with woodcut copies of the early figures published by Plancus, Gualtieri, and Ledermüller.

# 1. VAGINULINA LÆVIGATA, Roemer, 1838. Plate IV, fig. 9; Pl. V, fig. 8.

Part I, 1866, pp. 65, 66; and Append. I and II, Tables, No. 44 (Bridlington).

## *Additional Synonyms:*

*Orthocerata vaginulam gladii* referentia, *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, fig. 44 *m M*; Testaceogr., vol. ii, 1798, p. 141.

<sup>1</sup> 'Syst. Nat.,' edit. x, vol. i, 1758, p. 711, No. 248.

*Nautilus legumen*, Plancus, Conch. [1739], p. 16, pl. i, fig. 7; Gualtieri, Index [1742], pl. xix, fig. P.

'Syst. Nat.,' edit. xii, vol. i, part 2, 1767, p. 1164, No. 288.

*Nautilus legumen*, Plancus and Gualtieri, as above; Ledermüller, Micr. [1760, p. 17; 1761, p. 18], pl. viii, fig. g.

## FORAMINIFERA OF THE CRAG.

- Orthoceratia lævia subconica*, &c., *Soldani*, 1791. *Testaceogr.*, vol. i, part 2, p. 92, pl. xcvii, figs. *ee*, *ff* [*ee*, chambers discrete, smooth; *ff*, chambers compact, smooth].
- *Lituata*, &c., *Idem*. *Ibid.*, p. 95, pl. c, figs. *bb*?, *cc* [*bb*, *Dentalina*?, curved, chambers discrete, smooth; *cc*, *Vaginulina*, chambers discrete, smooth].
- Orthoceras Cuneus*, *Idem*. *Ibid.*, p. 98, pl. cv, figs. *T*, *V* [*T*, edge-view, compact and smooth; *V*, not quite compact, smooth].
- VAGINULINA LÆVIGATA, *Roemer*, 1838. *Neues Jahrb. f. Min.* for 1838, p. 383, pl. iii, fig. 11.
- — *Michelotti*, 1841. *Mem. Fisica Soc. Ital.*, vol. xxii, p. 278, pl. i, fig. 11.
- — *Reuss*, 1846. In *Geinitz's Grundriss*, &c., p. 657, pl. xxiv, fig. 12.
- BADENENSIS, *d'Orb.*, 1846. *For. foss. Vienne*, p. 65, pl. iii, figs. 6—8.
- LÆVIGATA, *Reuss*, 1856. *Sitz. k. Akad. Wiss. Wien*, vol. xviii, p. 226, pl. i, fig. 9.
- BEYRICHI, *Idem*, 1856. *Ibid.*, fig. 10 (*Marginulina*, at p. 226).
- LÆVIGATA, *Costa*, 1856. *Atti Accad. Pontan.*, vol. vii, part 2, pl. xvi, fig. 16.
- LEGUMEN, *Jones and Parker*, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi, pp. 453 and 457, pl. xix, figs. [26?], 27, 28.
- — var.  $\beta$ , *J.*, *P.*, and *B.*, 1866. *Monogr. Foram. Crag*, p. 65.
- LÆVIGATA, *J.*, *P.*, and *B.*, 1866. *Ibid.*, p. 66, pl. iv, fig. 9.
- LEGUMEN, *Brady*, 1867. *Proc. Somer. Arch. N. H. Soc.*, vol. xiii, p. 224, pl. i, fig. 18.
- LÆVIGATA, *Idem*, 1867. *Ibid.*, vol. xiii, p. 225, pl. i, fig. 19.
- LEGUMEN, *Blake*, 1876. *Yorkshire Lias*, p. 464, pl. xix, fig. 11.
- — *Morris*, 1876. *Lecture, Geol., Croydon*, p. 8, fig. 3 *b*.
- — var. LÆVIGATA, *Jones*, 1884. *Quart. Journ. Geol. Soc.*, vol. xl, p. 769, pl. xxxiv, fig. 5.
- — *Brady*, 1884. *Report 'Challenger'*, p. 530, pl. lxvi, figs. 13—15.
- — var. ARQUATA, *Brady*, 1884. *Ibid.*, p. 531, pl. cxiv, fig. 13.
- — var., *Sherborn and Chapman*, 1886. *Journ. R. Microsc. Soc.*, ser. 2, vol. vi, p. 753, pl. xv, figs. 19 *a*, *b*.
- — *Burrows, Sherborn, and Bailey*, 1890. *Journ. R. Microsc. Soc.*, p. 559, pl. x, fig. 16.
- — *Terrigi*, 1891. *Mem. R. Com. Geol. Ital.*, vol. iv, p. 94, pl. iii, fig. 6.
- LÆVIGATA, *Goës*, 1894. *K. Svensk. Vet.-Akad. Handl.*, vol. xxv, No. 9, p. 65, pl. xi, figs. 646—655.
- — *De Amicis*, 1895. *Nat. Sicil., Ann.* xiv, pp. 37 and 62.



VAGINULINA LEGUMEN, *Egger*, 1895. *Jahresb. Nat. Ver. Passau*, vol. xvi, p. 24, pl. ii, figs. 4 *a*, *b*, 8.

*Characters*.—Straight or curved; chambers more or less compact, smooth. The Bridlington specimen (Pl. IV, fig. 9) is retained here for comparison with the Crag specimen (Pl. V, fig. 8). The former (megalospheric) is straight, compressed, and symmetrical; the latter (microspheric?) is curved and tapering; it is of irregular growth in the later chambers, which are not uniform or compact.

*Occurrence*.—This, together with the limbate and costate forms, is widely distributed in shallow and deep seas. It occurs fossil, with other *Nodosariinæ*, in the Lias, and many later formations of Secondary, Tertiary, and Post-Tertiary ages.

2. VAGINULINA LINARIS (Montagu), 1808. Plate I, figs. 10—12; and Plate V, fig. 7.

Part I, 1866, pages 66, 67; and Appendices I and II, Tables, No. 43.

*Additional Synonyms:*

MARGINULINA VAGINELLA, *Reuss*, 1851. *Zeitsch. D. G. Ges.*, vol. iii, p. 152, pl. viii, fig. 2.

VAGINULINA STRIATA, *Costa*, 1856. *Atti Accad. Linc. Pontan.*, vol. vii, p. 182, pl. xvi, fig. 17.

NODOSARIA (VAGINULINA) LEGUMEN, var. LINEARIS, *Parker and Jones*, 1859. *Ann. Mag. Nat. Hist.*, ser. 3, vol. iv, pp. 346 and 351.

VAGINULINA LEGUMEN, var.  $\zeta$ , *P., J., and B.*, 1866. *Monogr. Foram. Crag*, p. 66 (add fig. 48 to the reference to Williamson's figures).

— LINEARIS, *Idem*, 1866. *Ibid.*, p. 67, pl. i, figs. 10—12.

— — *Sequenza*, 1880. *Atti R. Accad. Linc.*, ser. 3, vol. vi, p. 90, No. 247; p. 140, No. 636.

MARGINULINA BONONIENSIS (?), *Fornasini*, 1883. *Boll. Soc. Geol. Ital.*, vol. ii, p. 187, pl. ii, fig. 7 *e, f*.

VAGINULINA LINEARIS, *Brady*, 1884. Report 'Challenger,' p. 532, pl. lxvii, figs. 10—12.

— — *De Amicis*, 1893. *Boll. Soc. Geol. Ital.*, vol. xii, fasc. 3, p. 115.

— — *Goës*, 1894. *K. Svensk. Vet.-Akad. Handl.*, vol. xxv No. 9, p. 66, pl. xii, fig. 664.

— — *De Amicis*, 1895. *Nat. Sicil., Ann.* xiv, pp. 38 and 62.

*Characters*.—The shell is subcylindrical or compressed; somewhat tapering, straight or bent; chambers more or less compactly set on. The surface-ornament

of longitudinal costulæ is variable in expression and extent, frequently not affecting the youngest chambers, and sometimes limited to the earliest, and partially affecting the tops of the other chambers near to or just below the junction with the next segment. This kind of ornament is present in several *Dentalinæ*, such as *D. Sandbergeri*, *D. Girardana*, and *D. intermittens*, Reuss, 'Sitz. k. Akad. Wiss. Wien,' vol. xviii, 1856, p. 224, pl. i, figs. 5, 6, 7; and *D. proteus*, Reuss, *ibid.*, vol. xlv, 1861, p. 306, pl. i, figs. 6—9.

*Note.*—*Vaginulina striata*, d'Orb., after Soldani, is much compressed, symmetrically tapering, longitudinally costulate, compact, and rigid in its style of growth; and was taken as the type of *V. legumen*, var.  $\theta$  (Part I, p. 66). As this form has been included by some in *Vag. linearis*, its synonymy is here appended.

- Hortoceratia *vaginulam gladii referentia*, &c., Testa levissime in longum striata,  
Soldani, 1780. Saggio Orittoogr.,  
p. 108, pl. vi, figs. 44 *n N*.  
— seu tubuli concamerati, recti, striati, &c., *Idem*, 1798. Testaceogr.,  
vol. ii, Appendix, p. 141, pl. vi, figs. 44 *n N*.  
VAGINULINA STRIATA, d'Orbigny, 1827. Ann. Sci. Nat., vol. vii, p. 257, No. 3.  
— — Jones and Parker, 1860. Quart. Journ. Geol. Soc., vol. xvi,  
p. 302, No. 21.  
— — P., J., and B., 1871. Ann. Mag. N. H., ser. 4, vol. viii,  
p. 161.  
— — Fornasini, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 178.  
— — Fornasini, 1886. Boll. Soc. Geol. Ital., vol. v, p. 151,  
No. 39.  
— STRIATISSIMA, Schrodt, 1890. Zeitsch. Deutsch. Geol. Ges., vol. xlii,  
p. 412, pl. xxi, figs. 9 *a, b*.

*Occurrence.*—*Vaginulina linearis* is a shallow-water form, rather commonly met with off the British coasts, and apparently most at home in the waters of the North Temperate Zone. Specimens were obtained by the 'Challenger' from three stations:—Off Bermuda (435 fathoms), off Culebra Island (390 fathoms), and south-east of Pernambuco (350 fathoms). In a fossil condition it has been found in the London Clay (Eocene); Tertiary of Upper Silesia; the Miocene of Italy, and Muddy Creek (Victoria); and in the Pliocene of Italy.

So far as the Crag is concerned, we have nothing to add to the record from Sutton in the First Part of the Monograph.

## 3. VAGINULINA OBLIQUESTRIATA, sp. nov. Plate V, figs. 9, 10, 11.

*Characters*.—This *Vaginulina* is stout, subcylindrical, varying from straight to arcuate: fig. 11 is the straightest; fig. 9 has a gentle curve; and fig. 10 tapers and bends like a *Dentalina*. The chambers are closely set, marked off by very slightly oblique septa. The surface-ornament consists of rather strong, oblique, longitudinal costulæ, either extending the whole length of the shell (fig. 9), or interrupted at the sutures (figs. 10 and 11). These riblets are most oblique in fig. 10, less so in fig. 9, and are almost straight in fig. 11.

Although compact and ribbed this form is not so much compressed as the flat *V. striata*, d'Orb. (after Soldani), which is the type of var.  $\theta$  at page 66 of Part I, and it seems to require a distinct name.

A somewhat similar, but much stronger ornament is observable in the *Dentalina divergens*, Reuss, 1864 ('Sitz. k. Akad. Wiss. Wien,' vol. l, p. 456, pl. iv, fig. 10), with its strong oblique interrupted costulæ.

Of the various published *Vaginulinæ* related to *V. linearis* the following have oblique striæ.

- 1858. Williamson, 'Rec. Brit. For.,' pl. ii, figs. 46, 47 (*Dentalina legumen*, var. *linearis*).
- 1866. J., P., and B., 'Monogr. For. Crag,' pl. i, fig. 10 (*Vaginulina linearis*).
- 1882. Goës, K. Sv. Vet.-Ak. Handl., vol. xix, No. 4, pl. ii, fig. 33 (*Nodosarina legumen*, var. *linearis*).
- 1884. Brady, Report 'Challenger,' pl. lxvii, figs. 10, 11 (*Vaginulina linearis*).

*Occurrence*.—The figured specimens are in the Searles-Wood Collection, from Sutton, in the British Museum.

## Genus 5.—RHABDOGONIUM, Reuss, 1860.

Brady, Report 'Challenger,' 1884, pp. 70 and 524.

*Synonyms*:

VAGINULINA.—d'Orbigny, Parker, Jones, and Brady.

ORTHOCERINA.—d'Orbigny, Carpenter, Blake, Bütschli.

TRIPLASIA.—Reuss, Costa.

RHABDOGONIUM.—Reuss, Karrer, von Gümbel, von Hantken, Terquem, Schwager, Brady, Berthelin, Quenstedt, and others.

A Nodosarian test, straight, or slightly curved, angular or subcarinate; usually tri- or quadrangular in transverse section: chambers somewhat oblique or arched.



1. RHABDOGONIUM TRICARINATUM (*d'Orbigny*), 1826. Plate VII, figs. 16 *a*, *b*.

- VAGINULINA TRICARINATA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 258, No. 4;  
Modèle, No. 4.
- RHABDOGONIUM PYRAMIDALE, *Karrer*, 1861. Sitzungsab. k. Akad. Wiss. Wien,  
vol. xvi, p. 444, pl. i, fig. 5.
- VAGINULINA TRICARINATA, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3,  
vol. xvi, p. 19, No. 41, pl. i,  
fig. 34.
- ORTHOCERINA RHOMBOIDALIS, *Blake*, 1876. Yorkshire Lias, p. 470, pl. xvii,  
fig. 30.
- RHABDOGONIUM PYRAMIDALE, *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii,  
p. 25, pl. o, fig. 5.
- TRICARINATUM, *Brady*, 1884. Report 'Challenger,' p. 525,  
pl. lxvii, figs. 1—3.
- — [?], *Balkwill and Wright*, 1885. Trans. R. Irish  
Acad., vol. xxviii (Sci), p. 344,  
pl. xii, figs. 17, 18.
- — *Sherborn and Chapman*, 1886. Journ. R. Micr.  
Soc., ser. 2, vol. vi, p. 752  
pl. xv, figs. 16 *a*, *b*.
- — *Brady, Parker, and Jones*, 1888. Trans. Zool.  
Soc., vol. xii, part 7, p. 223,  
pl. xlv, fig. 3.
- — *Burrows, Sherborn, and Bailey*, 1890. Journ. R.  
Microsc. Soc., p. 558, pl. x,  
figs. 7 *a*, *b*.
- — (?), *De Amicis*, 1893. Boll. Soc. Geol. Ital.,  
vol. xii, fasc. 3, p. 106.
- — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss.,  
vol. xviii, part 2, p. 355, pl. xi,  
figs. 49, 50; pl. xii, figs. 36—38.
- — var. ACUTANGULUM, *Chapman*, 1894. Journ. R.  
Microsc. Soc. for 1894,  
p. 159, pl. iv, figs. 8 *a*, *b*.
- — *Egger*, 1895. Jahresb. Natur. Ver. Passau,  
vol. xvi, p. 23, pl. ii, figs.  
18 *a*, *b*, 19.

*Characters*.—Shell three-cornered, varying to quadrangular, tapering; curved or twisted; chambers compactly set on; aperture central, with or without a short neck.

*Occurrence*.—*Rhabdogonium tricarinatum* has a wide geographical and bathymetrical range, but is most common in the North Atlantic, and has not apparently been yet met with in the North Pacific. It is most common in comparatively shallow

water, but has been found at a depth of 1360 fathoms. D'Orbigny's type specimens were from the Adriatic, and the shell has been found recently in the Mediterranean (Brady). Geographically *Rh. tricarinatum* extends to the Gault of Folkestone; specimens have also been found in the Red Chalk of Speeton, in the London Clay (Eocene), in the Miocene of Malaga and Vienna, in the Pliocene of Italy and Garrucha (South Spain); and we have specimens in our own collections from the Casterlian and Scaldisian of Antwerp. In the Coralline Crag we have found it plentifully in every zone examined.

*Genus 6.*—MARGINULINA, *d'Orbigny*, 1827.

Part I, 1866, p. 68.

*Brady*, Report 'Challenger,' 1884, pp. 90 and 526.

*Additional Synonyms:*

MARGINULINA.—*Andreae*, *Stache*, *Philippi*, *Bailey*, *Hantken*, *Gümbel*, *Fornasini*, *Berthelin*, *Czjzek*, *Schwager*, *Sherborn*, *Chapman*, *Ehrenberg*, *Dunikowski*, *Mariani*, *Blake*, *Deecke*, *Toutkowsky*, *Zwingli*, *Kübler*, *Brown*, *Vanden Broeck*, *Basset*, *Balkwill and Wright*, *Mangin*, *Seguenza*, *Terrigi*, *Egger*, *Goës*, *Bronn*, *Greene*, *Hartwig*, *Nicholson*, *Moberg*, *M. Sars*, *Beudant*, *Franzenau*, *Rzehak*, *Mackie*, *Prestwich*, *Williamson*, *Schlicht*, *Ansted*, and others.

*General Characters.*—Test elongate, straight or curved, with a partially spiral commencement; subcircular or suboval in section; aperture marginal; shell smooth or ornamented.

1. MARGINULINA GLABRA, *d'Orbigny*, 1826. Plate I, fig. 26.

Part I, 1866, page 69; and Append. I and II, Tables, No. 45.

*Additional Synonyms:*

MARGINULINA ELONGATA, *d'Orb.*, 1840. *Mém. Soc. Géol. France*, vol. iv, p. 17,  
pl. i, figs. 20—22.  
— PEDIFORMIS, *Bornemann*, 1855. *Zeitsch. Deutsch. Geol. Ges.*,  
vol. vii, p. 326, pl. xiii, fig. 18.  
— CONTRACTA, *Costa*, 1856. *Atti Accad. Pont.*, vol. vii, p. 186, pl. xiii,  
fig. 10.

- MARGINULINA ABBREVIATA, *Karrer*, 1861. Sitzungsab. k. Akad. Wiss. Wien, vol. xlv, p. 445, pl. i, fig. 7.
- INÆQUALIS, *Reuss*, 1862. Ibid., vol. xlvi, p. 59, pl. v, fig. 13; pl. vi, fig. 8.
- INFARCTA, *Reuss*, 1863. Ibid., vol. xlviii, p. 48, pl. iii, figs. 36, 37.
- OPACA, *Stache*, 1864. Novara-Exped. Geol. Theil., vol. i, part 2, p. 214, pl. xxii, fig. 47.
- ANGISTOMA, *Idem*, 1864. Ibid., p. 213, pl. xxii, fig. 46.
- MUCRONULATA, *Idem*, 1864. Ibid., p. 215, pl. xxii, fig. 48.
- GLABRA, *Parker, Jones, and Brady*, 1865. Ann. Mag. N. H., ser. 3, vol. xvi, p. 27, pl. i, fig. 36.
- — *Brady*, 1868. Proc. Somers. Arch. N. H. Soc., vol. xiii, p. 225, pl. ii, fig. 22.
- — *Brady and Robertson*, 1870. Ann. Mag. N. H., ser. 4, vol. viii, Table, p. 360.
- SUBBULLATA, *Hantken*, 1875 (1881). Mitth. Jahrb. Ungar. Geol. Anstalt. vol. iv, p. 46, pl. iv, figs. 9, 10; pl. v, fig. 9.
- SPLENDENS, *Idem*, 1875. Ibid., p. 87, pl. iv, fig. 11.
- PEDIFORMIS, *Idem*, 1875. Ibid., p. 45, pl. iv, figs. 12, 13; and pl. v, fig. 8.
- CRISTELLARIA ARTICULATA, *Sequenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 140, pl. xiii, figs. 10, 10a.
- TRUNCULATA, *Berthelin*, 1880. Mém. Soc. Géol. France, ser. 3, vol. i; Mém. v, p. 53, pl. iii, figs. 26, 27.
- MARGINULINA GLABRA, *Brady*, 1884. Report 'Challenger,' p. 527, pl. lxxv, figs. 5, 6.
- BULLATA, *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 752, pl. xv, fig. 17.
- GLABRA, *Fornasini*, 1890. Mem. R. Accad. Sci. Bologna, ser. 4, vol. x, p. 470, plate, figs. 26, 28—30.
- — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 346, pl. xi, figs. 28, 29.
- VAGINULINA [MARGINULINA] GLABRA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xx, No. 9, pp. 65, 66, pl. xi, figs. 656—661.

Very numerous specimens of small Cristellarian and Marginuline passage-forms have been abundantly figured in various plates by d'Orbigny, Reuss, Schlicht, Terquem, Goës, and others. To collate and co-ordinate these exactly would be almost impossible. The foregoing synonymy, and that given by Signor G. A. De Amicis in the 'Bolletino Soc. Geol. Italiana,' vol. xii, fasc. 3, 1893, pp. 107, 108, will assist the student in this matter.



*Characters*.—A short, curved, partially spiral Nodosarine; with smooth, more or less inflated chambers, not numerous, and enlarging rapidly in process of growth. This little shell, which is very variable in its contours, feebly represents the far more compact and symmetrical *Cristellariæ*.

*Occurrence*.—*Marginulina glabra* has a wide geographical distribution, but apparently has not been met with in high latitudes. Specimens have been taken from depths ranging from 15 to 2740 fathoms. The geological range of the species is extensive. Specimens have been found in the Lias of England and the Continent; in the Cretaceous formations generally, both English and foreign; in the London Clay (Eocene), in the Oligocene of Germany, in the Miocene of Italy and Vienna; and in the Pliocene of Piedmont and Garrucha (South Spain). So far as the Crag is concerned, we have nothing to add to the record in Part I of the Monograph.

## 2. MARGINULINA COSTATA (*Batsch*), 1791. Plate I, fig. 21. (*M. raphanus*.)

Part I, 1866, page 70 (*Marginulina raphanus*); Append. I and II, Tables, No. 46.

### *Additional synonyms:*

- Orthoceratia* in longum striata, subconica, &c., *Soldani*,<sup>1</sup> 1791. Testaceogr., vol. i, part 2, p. 91, pl. xciv, figs. p, q, x, y.  
*Orthoceras Sublituus*, testa teres, striata, &c., *Soldani*, 1791. Ibid., p. 98, pl. civ, figs. f, g [= *Marginulina sublituus*, d'Orb.].  
*NAUTILUS (ORTHOCERAS) COSTATUS*, *Batsch*, 1791. Conchyl. Seesandes, p. 2, pl. i, figs. 1 a—g.  
*MARGINULINA SUBLITUUS*, d'Orbigny, 1826. Ann. Sci. Nat., vol. vii, p. 259, No. 9.  
— *RAPHANUS*, *Deshayes*, 1830. Hist. Nat. Vers., vol. ii, p. 418.  
— — *Ehrenberg*, 1838. Abhandl. k. Akad. Wiss. Berlin for 1838, p. 141, pl. i, fig. 2.  
— — *Cuvier*, 1836–46. Regne Animal, vol. ix, p. 35; vol. x, pl. xv, fig. 10.  
— — *Michelotti*, 1841. Mem. Soc. Ital. Sci., vol. xxii, p. 279.

<sup>1</sup> Soldani suggests that some of the specimens figured as "m, n, &c.," [m—z?] in plate xciv might be such as with Linnæus would be termed "*Raphani*, *Raphanistri*, et *Rapistri*." Soldani thinks that figs. p, q, and even y may be varieties of his "*Orthoceras Corniculum*." The nominal references in 'Ann. Mag. Nat. Hist.,' September, 1871, p. 163, and in the 'Challenger' Report, p. 528, for "n, p, q, r, x, y," are not quite correct. m, n, r, and v belong to *Nodosaria raphanus*; s to *D. obliqua*; t and z to *N. raphanistrum*.

- MARGINULINA RAPHANUS, *Reuss*, 1846. In *Geinitz's Grundriss Verstein*, p. 656, pl. xxiv, fig. 15.
- — — *Bronn*, 1851—6. *Leth. Geogn.*, edit 3, vol. iii, p. 238, pl. xxxv<sup>2</sup>, figs. 37 *a*, *b*.
- INTERAMNIE, *Costa*, 1856. *Atti Accad. Pont.*, vol. vii, p. 184, pl. xiii, fig. 9.
- NODOSARIA EXCENTRICA, *Costa*, 1857. *Mem. Accad. Sci. Napoli*, vol. ii, p. 137, pl. i, fig. 21.
- SUBLITUUS, *Jones and Parker*, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi, pl. xx, fig. 37.
- MARGINULINA OBLIQUESTRIATA, *Karrer*, 1861. *Sitz. k. Akad. Wiss. Wien*, vol. xlv, p. 446, pl. i, fig. 8.
- STRIATOCOSTATA, *Reuss*, 1862. *Ibid.*, vol. xlv, p. 62, pl. vi, fig. 2.
- TURGIDA, *Idem*, 1862. *Ibid.*, p. 63, pl. vi, fig. 7.
- NODOSARIA RAPHANUS, marginuline form, *Parker and Jones*, 1863. *Ann. Mag. N. H.*, ser. 3, vol. xii, p. 213.
- MARGINULINA RAPHANUS, *P. J. and B.*, 1865. *Ibid.*, vol. xvi, p. 19, pl. i, fig. 35.
- — — *Hartwig*, 1866. *The Sea*, edit. 3, p. 381, fig. *b*.
- — — *J. P. and B.*, 1866. *Monogr. Foram. Crag*, p. 70, pl. i, fig. 21.
- HAMUS, *Terquem*, 1866. *Foram. Lias*, 6me Mém., p. 501, pl. xxi, figs. 8 *a*, *b*.
- RADIATA, *Idem*. *Ibid.*, p. 505, pl. xxi, figs. 16, 17.
- RAPHANUS, *Brady*, 1867. *Proc. Somerset Arch. N. H. Soc.*, vol. xiii, p. 225, pl. ii, fig. 21.
- — — *P. J. and B.*, 1871. *Ann. Mag. N. H.*, ser. 4, vol. viii, pp. 163, 164, pl. x, figs. 72, 73.
- — — (?), *Greene*, 1871. *Manual Protozoa*, p. 15, figs. 3 *b*, *b'*.
- PICTA, *Blake*, 1876. *Yorkshire Lias*, p. 462, pl. xix, figs. 6, 6 *a*, *b*.
- RAPHANUS, *Blake*, 1876. *Ibid.*, p. 462, pl. xix, fig. 5.
- — — *Jones*, 1876. *Monthly Microsc. Journ.*, pl. cxxix, fig. 9.
- — — *Nicholson*, 1879. *Manual Palæont.*, vol. i, p. 114, fig. 18 *h*.
- — — var. CREBRICOSTA, *Sequenza*, 1880. *Atti R. Accad. Lincei*, ser. 3, vol. vi, p. 90, pl. ix, fig. 6.
- — — *Terrigi*, 1883. *Atti Accad. Pont. N. Lincei*, vol. xxxv, p. 180, pl. ii, fig. 17.
- — — *Jones*, 1883. *Microgr. Dict.*, edit. 4, p. 491, pl. xxiii, figs. 30—32.
- — — *Terrigi*, 1883. *Atti Accad. Pont. Nuovi Lincei*, vol. xxxv, p. 180, pl. ii, fig. 17.
- COSTATA, *Brady*, 1884. *Report 'Challenger'*, p. 528, pl. lxx, figs. 10—13.
- RAPHANUS, *Jones*, 1884. *Quart. Journ. Geol. Soc.*, vol. xl, p. 769, pl. xxxiv, fig. 6.
- COSTATA, *Fornasini*, 1886. *Boll. Soc. Geol. Ital.*, vol. v, fasc. 2, p. 192, and p. 201.

- NODOSARIA SEMEN, *Doderlein*, = MARGINULINA RAPHANUS, *Malagoli*, 1888. Atti Accad. Modena, ser. 3, vol. vii, fasc. 1, p. 2, pl. i, figs. 1, 2.
- MARGINULINA COSTATA, *Sherborn and Chapman*, 1889. Journ. R. Micr. Soc. for 1889, p. 487, pl. xi, fig. 28.
- PECKETI, *Schrodt*, 1890. Zeitsch. Deutsch. Geol. Ges., vol. xlii, p. 409, pl. xxi, fig. 1.
- COSTATA, *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, part 2, p. 347, pl. xi, fig. 19.
- — *Fornasini*, 1893. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iii, p. 434, pl. ii, fig. 6; vol. iv, 1894, pp. 213, 214, 217, pl. ii, figs. 19—21. (*Nodosaria* and *Marginulina cultrata*, and *Nod. constricta*, Costa.)
- NODOSARIA RAPHANUS, *Dervieux*, 1894. Boll. Soc. Geol. Ital., vol. v, fasc. 4, p. 621, pl. v, figs. 56—59.
- MARGINULINA ÆQUIVOCA (Rss.), *Chapman*, 1894. Journ. R. Microsc. Journ. for 1894, p. 162, pl. iv, fig. 20. (Eccentric *Nodosaria raphanus*.)
- MUNIERI (Berth.), *Idem*, 1894. Ibid., p. 163, pl. iv, fig. 22.
- ROBUSTA (Rss.), *Idem*, 1894. Ibid., p. 163, pl. iv, fig. 23.
- JONESI (Rss.), *Idem*, 1894. Ibid., p. 163, pl. iv, fig. 24.
- NODOSARIA MARGINULINOIDES, *Fornasini*, 1895. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. v, p. 10, pl. iv, fig. 7. (A passage-form.)
- CRISTELLARIA SULCATA, *Fornasini*, 1895. Ibid., p. 11, pl. iv, figs. 26, 27. (= *Cr. sulcata*, Costa; *M. costata*, with few ribs.)
- MARGINULINA COSTATA, *De Amicis*, 1895. Nat. Sicil., vol. xiv, pp. 35 and 61.

*Characters*.—This Nodosarine is essentially a *Nodosaria* having an eccentric growth, which gives either an oblique or partially spiral style of growth to the early chambers, and a marginal aperture (with or without a short neck) to the older and the last segments. It varies in cross-section from subcylindrical to oval and compressed. The chambers are moderately compact; more or less septate, and therefore varying in relative fulness; and are marked with longitudinal riblets, as in *Nodosaria raphanus*, of which, indeed, this is essentially only a Marginuline modification.

*Occurrence*.—*Marginulina costata* seems to be most at home in the North and South Atlantic, the Mediterranean, and the Adriatic (370—1240 fathoms); but



inferior specimens have been met with in British waters and off the coast of New Zealand. Its geological range extends to the Lias of England, Ireland, and France (Brady). It has also been found in the Kimeridge Clay (Brady); in the Cretaceous of Ireland (Wright); in the Eocene (London Clay); and in the Miocene of Italy, Malaga, Vienna, and Muddy Creek. In addition to the record from Sutton in the First Part of the Monograph, we have found one specimen at Broom Hill, zone d.

*Genus 7.*—CRISTELLARIA, *Lamarck*, 1812.

Part I, 1866, page 72.

*Brady*, Report 'Challenger,' 1884, pp. 70 and 534.

*Additional Synonyms:*

NAUTILUS.—*Plancus*, *Soldani*, *Montagu*, *Dillwyn*, &c.

POLYSTOMELLA.—*Lamarck*, *Blainville*, *Macgillivray*, *Thorpe*.

CREPIDULINA.—*Defrance*, *Blainville*.

NUMMULITES.—*Keferstein*.

PLANULARIA.—*Defrance*, *d'Orbigny*, *Münster*, *Römer*, *Hagenow*, *Philippi*, *Karsten*,  
*Boll*, *Jones and Parker*, *Brady*, *Wright*, *Blake*, *Seguenza*.

ROBULINA.—*Pictet*, *Michelotti*, *Bailey*, *Abich*, *Egger*, *Neugeboren*, *Deecke*, *Gümbel*,  
*Bornemann*, *Hantken*, *Mackie*, *Zwingli* and *Kübler*, *Dunikowski*,  
*Seguenza*, *Hagenow*, *Bailey*, *Coppi*, *Malagoli*, *Andreae*, *Karsten*,  
*Czjzek*, *Schwager*, &c.

MARGINULINA.—*Sowerby*, *Philippi*, *Cornuel*, *Jones and Parker*, *Bornemann*, *Brady*,  
*Gümbel*.

FRONDICULARIA.—*Costa*.

CRISTELLARIA.—*Kübler* and *Zwingli*, *Sherborn*, *Chapman*, *Brown*, *Burbach*,  
*Gümbel*, *Berthelin*, *Schwager*, *Andreae*, *Egger*, *Neugeboren*,  
*Hantken*, *Toutkowsky*, *Alth*, *Deecke*, *Olszewski*, *Blake*, *Uhlig*,  
*Stache*, *Dreyer*, *Toula*, *Agassiz*, *Michelotti*, *Suess*, *Basset*,  
*Quenstedt*, *Piette*, *Balkwill*, *Millett*, *Koenen*, *Prestwich*, *Goës*,  
*Egger*, *Vanden Broeck*, *Mariani*, *Dervieux*, *de Amicis*, *Fornasini*,  
*Rzehak*, *Nicholson*, *Bütschli*, *Marck*, *Marsson*, *Mantell*, *Mackie*,  
*Schlicht*, *Fric*, *Pictet*, *Beudant*, *Dixon*, *Eley*, *Mangin*, *Zittel*,  
*Vine*, *Malagoli*, *Steinmann*, *Schlumberger*, *Dunikowski*, *Hitchcock*,  
*Franzenau*, *Crouch*, *Bowdich*, *Wetherell*, *Ansted*, *Chimmo*,  
*Neumayer*, *Schrodt*, *Murray*, *Terrigi*, *Burrows*, *Bailey*, *Schacko*,  
*Stache*, *Beissel*, *Holzappel*, *Häusler*, *Pearcey*, *Guppy*, *Crick*,  
*Goës*, and others.

*General Characters.*—See also Part I, p. 72. Test planospiral in part or entirely; discoidal, complanate, lenticular (biconvex), crozier-shaped or ensiform; chambers subtriangular, sickle-shaped or of other hook-like form, mostly compact; smooth, limbate, granulose, or longitudinally costulate.

The smooth lenticular *Cristellaria* without a keel is *C. rotulata* (Lamarck); with a keel *C. cultrata* (Montfort); with broad, dentate keel, *C. calcar* (Linné); and when much compressed, broadly keeled, and ornamented, it is *C. cassis* (Fichtel and Moll). Parker and Jones adopted *C. calcar* as the best central and representative type of *Cristellaria*. *C. cultrata* and *rotulata* are inferior to it in point of development, whilst *C. cassis* surpasses it in the augmentation and diversity of ornamental and marginal growths.

As these forms are very variable in the several features and graduate one into the other, their separation into quasi-species is quite of an artificial character; and it is often difficult to determine to which group some individuals should be allocated. In the following synonymy only the best marked figured specimens have been noted.

*C. cultrata*, being present in the Crag, is here described.

# 1. CRISTELLARIA CULTRATA (Montfort), 1808. Plate I, figs. 24, 25.

Part I, 1866, Append. I and II, Tables, No. 47.

Cornu Hammonis, *Plancus*, 1739. De Conchis minus notis, &c., p. 12, pl. i, figs. 3, g, h, i;<sup>1</sup> edit. 2, 1760, p. 120, pl. i, figs. xii, s, t, v, and xiii z Z.

Corn-ammone, *Ginanni*, 1757. Opere postum., vol. ii; Test. Adriat., p. 20, pl. xiv, fig. 113.<sup>2</sup>

NAUTILUS CALCAR, *Linné*, 1758. Syst. Nat., 10th edit., p. 709; and 12th edit., 1767, p. 1162, No. 272. [This includes *Cristellaria cassis*, *calcar*, and *cultrata*.]

Nautili *Circumalati* seu *marginati* grandiusculi, *Soldani*, 1780. Saggio Oritt., p. 97, pl. i, fig. g.

<sup>1</sup> G. Bianchi states, at p. 13, that the majority of these have a broad pellucid margin around the shell; therefore they are the same as *C. cultrata*. In the 1760 edition there are added to the plate figs. xii, s, t, v, and xiii, Z z, which appear to be true *cultrata*. The fig. 3 quoted above appears to belong to the minority, namely, those without the broad pellucid margin, and is therefore *rotulata*; and this notwithstanding the remark at p. 13, that the artist has not (but might have) shown the marginal flange. See also Fornasini, 'Boll. Soc. Geol. Ital.,' vol. vi, 1887, p. 38.

<sup>2</sup> In these posthumous papers of Count Giuseppe Ginanni, of Ravenna, fig. 113 is evidently a bad drawing of *Cristellaria cultrata*; and, as is the case also with figs. 112 and 114, it has an irrelevant description taken wrongly from Plancus. Fig. 111 is one face, and fig. 112 probably the other of *Rotalia Beccarii*; and fig. 114 is possibly a poor *Crist. cassis*.

- N. lævi-lucido-umbilicati*, *Soldani*, 1780. Ibid., p. 99, pl. i, fig. o.
- NAUTILUS CALCAR, *Walker and Jacob*, 1784. Test. min., &c., p. 19, pl. iii, fig. 66  
(and Kanmacher; Adams' Essays).
- Nautili (*Lenticulæ marginatæ*), *Soldani*, 1789. Testaceograph., vol. i, part 1, p. 54,  
pl. xxxiii, figs. A, B.
- N. carinati* (*Lenticulæ*), *Idem*, 1789. Ibid., p. 64, pl. lviii, figs. *ee*, *ff*, *gg*, *ii*, *kk*,  
(Figs. *gg* and *ii* have entire keels; but  
the other specimens either are passages  
into *C. calcar*, figs. *hh*, *mm*, &c., or have  
their keels chipped by accident.)
- NAUTILUS CALCAR, var.  $\beta$ , *Fichtel and Moll*, 1803. Test. Microsc., &c., p. 69, pl. xi,  
figs. *d—f*; var.  $\zeta$ , pl. xii,  
figs. *d—f*; var.  $\lambda$ , pl. xiii,  
figs. *e—g*.
- — *Montagu*, 1803. Test. Brit., &c., p. 189, pl. xv, fig. 4.
- ROTATUS, *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 114.
- ROBULUS CULTRATUS, *Montfort*, 1808–10. Conch. Syst., p. 214, genre liv.
- ROBULINA CULTRATA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 287, No. 1;  
Modèle No. 82.
- ROTALIA, *Sowerby and Wetherell*, 1834. Trans. Geol. Soc., ser. 2, vol. v, p. 135,  
pl. ix, fig. 13.
- CRISTELLARIA OSNABURGENSIS, *Münster and Roemer*, 1838. Neues Jahrb. f. Min.,  
&c., 1838, p. 391,  
pl. iii, fig. 62.
- ROBULINA CANARIENSIS, *d'Orb.*, 1839. Foram. Canaries, &c., p. 127, pl. iii,  
figs. 3, 4.
- CULTRATA vel SUBCULTRATA, *d'Orb.*, 1839. Foram. Amér. Mérid., &c.,  
p. 26, pl. v, figs. 19, 20.
- EHRENBURGII, *Roemer*, 1841. Verstein. Norddeutsch. Kreidegeb., p.  
98, pl. xv, fig. 31; R. COMPTONI,  
*Idem*, ibid., fig. 33.<sup>1</sup> (Both are de-  
scribed as being keeled, but Sowerby's  
figured type of *C. Comptoni* is not  
keeled.)
- DEPRESSA, *Michelotti*, 1841. Mem. Soc. Ital. Sc., vol. xxii, pp. 291 and  
302, pl. ii, fig. 3.
- CUMMINGII, *Idem*. Ibid., p. 292, pl. ii, fig. 4.
- CULTRATA, *Idem*. Ibid., p. 291, pl. ii, fig. 5.
- CRISTELLARIA PLANICOSTA, *Hagenow*, 1842. Neues Jahrb. f. Min., &c., 1842, p.  
572, pl. ix, fig. 24.
- LOBATA, *Reuss*, 1845. Verstein. Böhm. Kreid., I, p. 34, pl. xiii, fig. 59.
- ROBULINA CULTRATA, *d'Orb.*, 1846. Foram. Foss. Vienne, p. 96, pl. iv, figs. 10–13.
- SIMILIS, *Idem*. Ibid., p. 98, pl. iv, figs. 14, 15.
- CLYPEIFORMIS, *Idem*. Ibid., p. 101, pl. iv, figs. 23, 24.
- CULTRATA, *Pilla*, 1846. Dist. Etruria, p. 104, pl. i, fig. 9.

<sup>1</sup> Given as fig. 34 in the text, but more correctly fig. 33 at the foot of the plate.



- NONIONINA MAGDEBURGICA, *Philippi*, 1846. *Palæontographica*, vol. ii, p. 81, pl. xA, fig. 21.
- ROBULINA CUMMINGI, *Michelotti*, 1847. *Nat. Vet. Hollandische Maatschap. Wetensch. Haarlem*, ser. 2, vol. iii, p. 14, pl. i, fig. 3.
- STELLIFERA, *Czjzek*, 1848. *Haidingers Naturw. Abhandl.*, vol. ii, p. 142, pl. xii, figs. 26, 27 (narrow keel).
- CRISTELLARIA VARIABILIS, *Reuss*, 1850. *Denksch. k. Akad. Wien*, vol. i, p. 369, pl. xlv, figs. 15, 16.
- ROBULINA GALEATA (afterwards CASSIDEA), ANGUSTIMARGO, DIMORPHA, UMBONATA, NITIDISSIMA, TRIGONOSTOMA, DEFORMIS, *Reuss*, 1851. *Zeitsch. Deutsch. Geol. Gesell.*, vol. iii, pp. 67—70, pl. iv, figs. 21—26, 30.
- D'ORBIGNII, *Bailey*, 1851. *Smithsonian Contrib. Knowl.*, vol. ii, Art. 3, p. 10, pl. o, figs. 9, 10; *Phil. Trans.*, vol. clv, 1865, p. 425.
- CRISTELLARIA PLATYPLEURA, *Jones*, 1852. *Quart. Journ. Geol. Soc.*, vol. viii, p. 267, pl. xvi, fig. 12.
- ROTALIA INCRASSATA, &c., *Ehrenberg*, 1854. *Mikrogeologie*,<sup>1</sup> pl. xxiii, figs. 40, 44, 45, 47—50; pl. xxv, I, fig. 40; pl. xxvi, fig. 53 (CRISTELLARIA HOFFMANNI, *Ehr.*); pl. xxvii, figs. 37, 46; pl. xxviii, figs. 43—49, 54, 55; pl. xxx, figs. 27, 32, 35; pl. xxxii, II, figs. 37, 47.
- CRISTELLARIA ORBICULA, *Reuss*, 1854. *Denksch. k. Akad. Wiss. Wien*, vol. vii, p. 68, pl. xxv, fig. 12.
- SUBALATA, *Idem.* *Ibid.*, vol. vii, p. 68, pl. xxv, fig. 13.
- CULTRATA, *Parker, Jones, and Brady*, 1855. *Ann. Mag. Nat. Hist.*, ser. 3, vol. xvi, p. 32.
- PROMINULA, *Reuss*, 1855. *Zeitsch. Deutsch. Geol. Gesell.*, vol. vii, p. 271, pl. ix, fig. 3.
- ROBULINA MEGALOPOLITANA, *Idem.* *Ibid.*, p. 272, fig. 5.
- CRISTELLARIA EXCISA, *Bornemann*, 1855. *Ibid.*, vol. vii, p. 328, pl. xiii, fig. 20.
- ROBULINA DEFORMIS, *Idem.* *Ibid.*, vol. vii, p. 337, pl. xiv, figs. 1—3.
- NAVIS, *Idem.* *Ibid.*, vol. vii, p. 338, pl. xiv, fig. 4.
- AUGUSTIMARGO, *Idem.* *Ibid.*, vol. vii, p. 332, pl. xiv, figs. 6, 7.
- BEYRICHI, *Idem.* *Ibid.*, vol. vii, p. 332, pl. xiv, figs. 8—10?
- INCOMPTA, *Idem.* *Ibid.*, vol. vii, p. 336, pl. xiv, fig. 12.
- RADIATA, *Idem.* *Ibid.*, vol. vii, p. 334, pl. xv, fig. 1.
- LIMBATA, *Idem.* *Ibid.*, vol. vii, p. 335, pl. xv, figs. 4—6.
- TRIGONOSTOMA, *Idem.* *Ibid.*, vol. vii, p. 336, pl. xv, fig. 9.
- DECLIVIS, *Idem.* *Ibid.*, vol. vii, p. 333, pl. xv, fig. 11.
- INTEGRA, *Idem.* *Ibid.*, vol. vii, p. 334, pl. xv, figs. 12—14, 16.

<sup>1</sup> See also 'Monatsb. and Abhandl. Akad.,' Berlin; and 'Ann. Mag. Nat. Hist.,' March, 1872, pp. 226, 282, 288, 291, 293, 300; September, 1872, pp. 189 190.

## FORAMINIFERA OF THE CRAG.

- ROBULINA COMPRESSA, *Bournemann*, 1855. *Zeitsch. Deutsch. Geol. Gesell.*, vol. vii, p. 338, pl. xv, fig. 17.
- CLYPEIFORMIS, var. FESTONATA, *Costa*, 1856. *Atti Accad. Pontan.*, vol. vii, p. 196, pl. x, figs. 11, A, B, C.
- SUBANGULOSA, *Idem.* *Ibid.*, vol. vii, pl. xiv, figs. 2 A, B, C (feeble keel).
- FESTONATA, *Idem.* *Ibid.*, vol. vii, p. o, pl. xix, figs. 1, A B.
- CRISTELLARIA MAGNA, *Idem.* *Ibid.*, vol. vii, p. 193, pl. xix, figs. 2 A, B.
- ROBULINA INÆQUALIS, *Idem.* *Ibid.*, vol. vii, p. 229, pl. xix, figs. 3 A, B (few chambers).
- CULTRATA, *Idem.* *Ibid.*, vol. vii, p. 198.
- — *Bronn*, 1851-56. *Lethæa Geogn.*, edit. 3, vol. iii, p. 207, pl. xxxv<sup>2</sup>, fig. 9.
- COMPRESSA, *Egger*, 1857. *Neues Jahrb. f. Min., &c.*, 1857, p. 297, pl. xv, figs. 12, 13.
- CRISTELLARIA CALCAR (including CULTRATA), *Parker and Jones*, 1857. *Ann. Mag. Nat. Hist.*, ser. 2, vol. xix, pp. 289—291, pl. x, figs. 10—12.
- PRIMA, *Terquem*, 1858. *Mém. Acad. Imp. Metz*, 1858, p. 621, pl. iii, fig. 16. (Feeble keel, and last chamber expanding.)
- CALCAR, *Williamson*, 1858. *Rec. Brit. Foram.*, p. 25, pl. ii, figs. 52, 53. (Almost keel-less.)
- CASSIS, var., *Jones and Parker*, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi, pp. 453, 454, 457, pl. xx, fig. 41.
- — ROTULATA, *Idem.* *Ibid.*, vol. xvi, pp. 453, 454, 457, pl. xx, figs. 42, 43.
- MICROPTERA, *Reuss*, 1860. *Sitzungsb. k. Akad. Wiss. Wien*, vol. xl, p. 215, pl. viii, fig. 7.
- CULTRATA, *Silvestri*, 1862. *Atti X Congresso Scienz. Ital.*, p. 17.
- SUBALATA, *Reuss*, 1863. *Sitz. k. Akad. Wiss. Wien*, vol. xlvi, p. 76, pl. viii, fig. 10; and pl. ix, fig. 1.
- TURGIDULA, *Idem.* *Ibid.*, vol. xlvi, p. 73, pl. viii, fig. 4.
- ROBULINA RADIATA, *Idem.*, 1864. *Ibid.*, vol. xlvi, p. 54, pl. vi, fig. 65 (many-chambered). [*Cristellaria grata* in 1865.]
- DEPAUPERATA, *Idem.* *Ibid.*, vol. xlvi, p. 54, pl. vi, figs. 67, 68; pl. viii, figs. 90, 91 var. *callifera* (few-chambered).
- LIMBOSA, *Idem.* *Ibid.*, vol. xlvi, p. 55, pl. vi, fig. 69.
- NODOSARINA (CRISTELLARIA) CULTRATA et ROTULATA, *Jones and Parker*, 1864. *Geologist*, vol. vii, p. 88.
- CRISTELLARIA CULTRATA, *Parker, Jones, and Brady*, 1865. *Ann. Mag. Nat. Hist.*, ser. 3, vol. xvi, p. 32, pl. i, fig. 39.
- — et ROTULATA, *Parker and Jones*, 1865. *Phil. Trans.*, vol. clv, p. 344, pl. xiii, figs. 17—19; and pl. xvi, fig. 5. (Fig. 19 is not quite destitute of keel.)

- ROBULINA PRINCEPS, *Reuss*, 1865. Sitzungsber. Akad. Wiss. Wien, vol. I, p. 466, pl. v, fig. 3.
- CRISTELLARIA GYROSCALPRUM, *Stache*, 1865. Novara-Exped. Geol. Theil., vol. i, part 2; Paläont., p. 243, pl. xxiii, figs. 22 *a*, *b*.
- ROBULINA CULTRATA, var. ANTIPODUM, *Idem*, 1865. Ibid., p. 251, pl. xxiii, figs. 30 *a*, *b*.
- TAETTOWATA, *Idem*, 1865. Ibid., p. 252, pl. xxiii, figs. 32 *a*, *b*.
- [Other individuals figured on the same plate illustrate passage-forms and near alliances. A similar remark may be made on Cristellarian groups figured on many a page in the works of Seguenza, Reuss, Bornemann, d'Orbigny, Terquem, and others.]
- CRISTELLARIA CALCAR, var. CULTRATA, *Reuss*, 1866. Denksch. k. Akad. Wiss. Wien, vol. xxv, p. 145.
- COMMUNIS, *Kübler and Zwingli*, 1866. Neujahrsblatt Bürgerbibliothek Winterthur, p. 10, pl. i, figs. 22, 23.
- SIMPLEX, *Idem*, 1866. Ibid., fig. 28.
- ROTALINA, *Idem*, 1866. Ibid., p. 11, pl. ii, fig. 4.
- CULTRATA, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, pl. i, figs. 24, 25.
- — *Brady*, 1867. Proc. Somerset Arch. Nat. Hist. Soc., vol. xiii, p. 227, pl. iii, fig. 37.
- ROBULINA ALATOLIMBATA, *Gümbel*, 1868. Abhandl. k. Akad. Bayer. Wiss., Cl. II, vol. x, Abth. 2, p. 641, pl. i, fig. 70 (almost vorticial).
- PTERODISCOIDEA, *Idem*, 1868. Ibid., p. 642, pl. i, fig. 72 (many-chambered).
- CRISTELLARIA ROTALINA, *Zwingli and Kübler*, 1870. Foram. Schweiz. Jura, p. 10, pl. i, Jurensismergel, fig. 3.
- SIMPLEX, *Idem*, 1870. Ibid., fig. 4; and p. 27, pl. iii, fig. 28.
- COMMUNIS, *Idem*, 1870. Ibid., fig. 5; and Posidonienschiefer, fig. 4; and p. 27, pl. iii, fig. 27.
- BIRMENSTORFENSIS, *Idem*, 1870. Ibid., p. 29, pl. iii, fig. 36.
- No. 302, *Schlicht*, 1870. Foram. Pietzpuhl, p. 52, pl. xvi, fig. 1 (*C. spectabilis*, Reuss).
- ROBULINA, No. 313, *Idem*. Ibid., p. 54, pl. xvii, figs. 7, 8 (*C. articulata*, Reuss); No. 316, p. 54, figs. 11, 12 (*C. articulata*, Reuss); No. 319, p. 55, pl. xvii, figs. 17, 18 (*C. simplex*, var. *incompta*, Reuss); No. 320, p. 55, pl. xviii, figs. 1, 2 (the same); No. 322, p. 55, pl. xviii, figs. 3, 4 (*C. deformis*, Reuss); No. 321, p. 55, pl. xviii, figs. 7, 8 (*C. simplex*, var. *incompta*, Reuss); No. 323, p. 55, pl. xviii, figs. 15, 16 (the same); No. 334, p. 57, pl. xix, figs. 13, 14 (*C. limbosa*, Reuss); No. 332, p. 57, pl. xix, figs. 7, 8 (*C. platyptera*, Reuss).
- CRISTELLARIA CULTRATA, *P., J., and B.*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 240, pl. x, fig. 84.



- ROBULINA CALCAR, var. CULTRATA, *Hantken*, 1875. Mittheil. Jahrb. k. Ungar. Geol. Anstalt, vol. iv, part 1, p. 55.
- DEPAUPERATA, *Idem*, 1875. Ibid., vol. iv, p. 55, pl. vi, figs. 5, 6; pl. xiv, fig. 16 (figs. 6 and 16 few-chambered).
- PRINCEPS, *Idem*, 1875. Ibid., vol. iv, part 1, p. 56, pl. vi, fig. 8.
- LIMBOSA, *Idem*, 1875. Ibid., vol. iv, part 1, p. 57, pl. vi, fig. 11.
- BUDENSIS, *Idem*, 1875. Ibid., vol. iv, part 1, p. 58, pl. vii, fig. 1 (?).
- CRISTELLARIA CULTRATA, *Vanden Broeck*, 1876. Ann. Soc. Belge Microsc., vol. ii, p. 107, pl. iii, figs. 3 and 6; and Fonds de la Mer, vol. iii, 1876, pp. 93, 94, pl. iii, figs. 3 and 6.
- FALCATA, *Karrer*, 1878. Foram. Tert. Thone Luzon, p. 93, pl. v, fig. 19.
- ROBULINA TENUIS, *Sequenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 143, pl. xiii, fig. 26.
- VITREA, *Idem*, 1880. Ibid., ser. 3, vol. vi, p. 144, pl. xiii, fig. 27.
- DUBIA, *Idem*, 1880. Ibid., ser. 3, vol. vi, p. 144, pl. xiii, fig. 30.
- CRISTELLARIA CULTRATA, *Terrigi*, 1880. Atti Acc. Pontif. Nuovi Lincei, vol. xxxiii, p. 182, pl. i, fig. 12.
- CIRCUMCIDANEA, *Berthelin*, 1880. Mém. Soc. Géol. France, ser. 3, vol. i, Mém. No. 5, p. 52, pl. iii (xxvi), fig. 1.
- DIADEMATA, *Idem*, 1880. Ibid., p. 51, pl. xxvi, fig. 4.
- MACRODISCA, *Idem*, 1880. Ibid., p. 48, pl. xxvi, fig. 11.
- INGENUA, *Idem*, 1880. Ibid., ser. 3, vol. i, Mém. No. 5, p. 54, pl. xxvi, figs. 20, 21.
- CULTRATA, *Jones*, 1882. Catal. Foss. Foram. Brit. Mus., pp. 9, 14, 19, 21, 43, 52, 55, 56, 69, 71, 79, 87, 90, 94.
- NODOSARINA CALCAR (including CULTRATA), *Goës*, 1882. Kongl. Svenska Vet.-Akad. Handl., vol. xix, No. 4, pp. 49—52, pl. iii, figs. 57—59.
- CRISTELLARIA ROTULATA, var. ROEMERI, *Uhlig*, 1883. Jahrb. Geol. Reichsanst. Wien, vol. xxxiii, p. 751, pl. ix, figs. 1—3 (with very narrow keel).
- CULTRATA, *Idem*, 1883. Ibid., vol. xxxiii, p. 754.
- — *Jones*, 1883. Micrograph. Dict., edit. 4, p. 214, pl. xxiii, figs. 37 a, b.
- — *Idem*, 1884. Quart. Journ. Geol. Soc., vol. xl, p. 765, pl. xxxiv, figs. 10, 11.
- ROTULATA, *Jones*, 1884. Ibid., vol. xl, p. 765, pl. xxxiv, fig. 9 (with a slight partial keel).
- CULTRATA, *Brady*, 1884. Report 'Challenger,' pp. 70 and 550, pl. lxx, figs. 4—8.

- CRISTELLARIA CULTRATA, *Fornasini*, 1884. Boll. Soc. Geol. Ital., vol. iii, pp. 89, 90.
- — — *Koenen*, 1885. Abhandl. Ges. Wiss. Göttingen, vol. xxxii, p. 107, pl. v, figs. 13 *a*, *b*.
- — — *Fornasini*, 1885. Boll. Soc. Geol. Ital., vol. iv, p. 114.
- — — — 1886. Ibid., vol. v, pp. 139, 140, 154, 180.
- ROBULINA CULTRATA, *Basset*, 1885. Ann. Soc. Charente-Inf. for 1884, p. 163, No. 82.
- CRISTELLARIA CASSIS (adult), *Basset*, 1885. Ibid., p. 162, fig. 83.
- MAMILLARIS, *Terquem*, 1886. Mém. Soc. Géol. France, ser. 3, vol. iv, Mém. No. 2, p. 37, pl. iv (x), fig. 4 (only).
- RADIATA, *Uhlig*, 1886. Jahrb. Geol. Reichsanst., vol. xxxvi, Heft 1, p. 169, cut fig. 2.
- —<sup>1</sup> *Fornasini*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 29.
- INORNATA, *Sherborn and Chapman*, 1887. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 754, pl. xv, fig. 27 *a*, *b* (feebly carinate).
- CULTRATA, *Idem*. Ibid., ser. 2, vol. vi, p. 754, pl. xv, figs. 28 *a*, *b*.
- — var. SPLENDENS, *Idem*. Ibid., ser. 2, vol. vi, p. 755, pl. xv, figs. 29 *a*, *b*.
- MEGALOPOLITANA, *Idem*. Ibid., ser. 2, vol. vi, p. 755, pl. xv, fig. 30.
- CULTRATA, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 224, pl. xlv, fig. 13.
- — var., *Prestwich*, 1888. Geology, vol. ii, p. 352, 175 *c*.
- ROBULINA GLAUCA [*Doderlein*], *Malagoli*, 1888. Att. Soc. Nat. Modena Memorie, ser. 3, vol. vii, p. 4, pl. i, figs. 3—5.
- CRISTELLARIA CULTRATA, *Mariani*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 287, pl. x, fig. 12.
- — — *Häusler*, 1890. Abhandl. Schweiz. paläont. Gesell., vol. xvii, p. 114, pl. xv, figs. 4, 5, 11.
- ROTULATA, var.,<sup>2</sup> *Wisniewski*, 1890. Pamietnik Akad. Umiejet Krakow, vol. xvii, p. 220, pl. ix, fig. 21 *b*.
- CULTRATA, *Terrigi*, 1891. Mem. Com. Geol. Ital., vol. iv, p. 96, pl. iii, figs. 13—15.
- SOLDANII, *Idem*, 1891. Ibid., p. 98, pl. iii, figs. 19, 20.
- DEPRESSA, *Dervieux*, 1891. Boll. Soc. Geol. Ital., vol. x, p. 39, pl. i<sup>a</sup>, figs. 10, 11.
- CULTRATA, *Idem*, 1891. Ibid., p. 45.
- BUDENSIS, var., *Idem*, 1891. Ibid., p. 49, pl. i<sup>a</sup>, fig. 16.

<sup>1</sup> Several specimens "differing in size, in the breadth of the keel or crest, in the degree of compression, in the projection of the umbilical disc, or the sutures, &c."

<sup>2</sup> Several modifications of *C. rotulata*, *cultrata*, and *calcar* are figured in pls. ix and x.

- CRISTELLARIA CULTRATA, *Idem*, 1892. Boll. Soc. Geol. Ital., vol. x, p. 582.
- — *Malagoli*, 1892. Ibid., vol. xi, p. 95.
- — *Hosius*, 1892. Verhandl. nat. Ver. preuss. Rheinland, 49 Jahrg., p. 189.
- — *Crick and Sherborn*, 1892. Journ. Northamptonshire Nat. Hist. Soc., vol. vii, p. 70, pl. vii, fig. 13.
- ROTULATA, *Egger*, 1893. Abhandl. Bayer. Akad. Wiss., vol. xviii, p. 351, pl. xii, fig. 2 (not quite keelless).
- CULTRATA, *Idem*. Ibid., figs. 7—10, 24, 25.
- — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, fasc. 3, p. 417 (synonyms).
- — *Fornasini*, 1894. Mem. R. Accad. Sci. Istit. Bologna, ser. 5, vol. iv, pp. 221, 222, pl. iii, figs. 26, 27; vol. v, 1895, p. 12, pl. iv, fig. 31 (fig. 27 = *Cr. festonata*, Costa).
- ROTULATA (including CULTRATA), *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 59, pl. x, figs. 559—578.
- CULTRATA, *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 43 and 62.
- ROTULATA, *Egger*, 1895. Jahresb. Naturhist. Ver. Passau, p. 26, pl. iii, figs. 4, 7.

NOTE.—The synonymy of *Cristellaria cultrata* and its very numerous allies is dealt with in the "Remarks on the Foraminifera with especial reference to their Variability of Form, illustrated by the Cristellarians," by Prof. T. Rupert Jones, in the 'Monthly Microsc. Journ.,' vol. xv, 1876, pp. 61—92, and pp. 20, 201. At pp. 77—84 the synonymy of the varietal modifications of *Cristellaria calcar*, whether keelless or keeled, rowelled, outspread, trihedral, or elongate, is detailed, as indicated by published forms, from 1735 to 1846. The second part (by T. R. Jones and C. D. Sherborn) of the same memoir appeared in the 'Journ. Roy. Microsc. Society,' vol. for 1887, part 2, pp. 545—557. The selection for the synonymy is chiefly guided by the absence of ornament and of any peculiarity in the shape of the chambers, and doubtless is merely an artificial arrangement of the forms lying between *C. rotulata* and *C. cassis*.

*Characters*.—Shell lenticular, nautiloid, smooth, consisting of one or more spiral whorls of subtriangular or falciform chambers, the outermost embracing the inner whorls. Septal sutures variable in expression; sometimes sunken, often limbate. Umbones sometimes much thickened. Margin keeled; carina narrow or wide. Aperture round or angular.

Diameter of specimens from the Crag about one-twentieth of an inch ( $1\frac{1}{2}$  mm.); but some from other sources attain very much larger dimensions.

*Occurrence*.—*Cristellaria cultrata* is found in various fossiliferous strata, com-



mening with the Silurian;<sup>1</sup> it is represented in the Lias and Oolite, and abounds in the Gault, Chalk-marl, and Chalk. Together with cognate forms or varieties, it is plentiful in many Tertiary deposits at home and abroad. Recent specimens are not very common, but have been found in Arctic, Atlantic, and North-Pacific dredgings at considerable depths, and in the Mediterranean and Adriatic Seas. In the Crag it is very rare, one or two smallish specimens from Sutton, and Thorpe, near Norwich, in Mr. Wood's Collection, being the only reliable examples we have seen.

Together with its ally, *C. rotulata*, this *Cristellaria* is widely diffused in seas and oceans, as far north as the Arctic Circle on the coast of Norway, and down south on the shores of Patagonia. Fine specimens are rarely found at less depth than 100 fathoms. *C. cultrata* was collected by the 'Challenger' in the North Atlantic at from 390 to 2435 fathoms; in the South Atlantic at 350 and 675 fathoms; in the South Pacific from 38 to 275 fathoms; and in the North Pacific at 95 fathoms. It lives also in the Mediterranean and Adriatic. Small specimens with narrow keel occur in shallow water in the British seas.

## 2. CRISTELLARIA GIBBA, *d'Orbigny*. Plate VII, figs. 19 *a*, *b*.

- CRISTELLARIA GIBBA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 292, No. 17.  
 — — *Idem*, 1839. Foram. Cuba, p. 40, pl. vii, figs. 20, 21.  
 — EXCISA, *Bornemann*, 1855. Zeitsch. Deutsch. Geol. Ges., vol. vii,  
     p. 328, pl. xiii, fig. 19.  
 — NUDA, *Reuss*, 1861. Sitzungsber. k. Akad. Wiss. Wien, vol. xlv,  
     p. 328, pl. vi, figs. 1—3.  
 — PULCHELLA, *Idem*, 1862. Ibid., vol. xlvi, p. 71, pl. viii, fig. 1.  
 ROBULINA CONCINNA, *Idem*, 1863. Ibid., vol. xlviii, p. 52, pl. v, fig. 58.  
 CRISTELLARIA GIBBA, *Brady*, 1884. Report 'Challenger,' p. 546, pl. lxix, figs. 8, 9.  
 — — *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Micr. Soc.,  
     p. 559, pl. x, figs. 19 *a*, *b*, 21.  
 — — *Crick and Sherborn*, 1891. Journ. Northampt. Nat. Hist.  
     Soc., vol. vi, p. 212, pl. vi, fig. 29.  
 — — *Chapman*, 1896. Journ. Roy. Micr. Soc. for 1896, p. 4,  
     pl. i, figs. 7 *a*, *b*.

*Characters*.—This small subovate form is one of the many intermediate to the closely coiled *Cristellaria rotulata* and the more expanded and elongate

<sup>1</sup> *Cristellaria rotulata* (?), Schlumberger, 'Journ. Cincinnati Soc. Nat. Hist.,' vol. v, 1882, p. 119, pl. v, figs. 2, 2 *a*. *Cristellaria*, sp., Terquem, is found in the Devonian, 'Bulet. Soc. Géol. France,' ser. 3, vol. viii, 1880, p. 418, pl. xi, fig. 8.

*C. crepidula*. It has many congeners, varying in relative thickness and other unimportant features.

*Occurrence*.—In the North Atlantic and South Pacific at less than 500 fathoms, but it is credited with a much wider area for its habitats. Under various names it may be recognised in descriptions of fossil *Cristellariæ* from both Mesozoic and Cainozoic deposits. We have it from the Crag at Sutton, zone f.

It has been found fossil in the Neocomian (Bargate beds); Cretaceous (Red Chalk); Oligocene of Elsass; and the Miocene and Pliocene of Italy.

### 3. CRISTELLARIA RENIFORMIS, *d'Orbigny*. Plate VII, figs. 18 a, b.

- |                          |                       |  |
|--------------------------|-----------------------|--|
| CRISTELLARIA RENIFORMIS, | <i>d'Orb.</i> , 1846. | Foram. Foss. Vienne, p. 88, pl. iii, figs. 39, 40.   |
| —                        | —                     | <i>Pictet</i> , 1857. <i>Traité Paléont.</i> , edit. 2, vol. iv, p. 495, pl. cix, fig. 13.                                 |
| —                        | —                     | <i>Neugeboren</i> , 1872. <i>Archiv Ver. Siebenburg. Landeskunde</i> , n. f., vol. x, part 2, p. 277, pl. i, figs. 11, 12. |
| —                        | —                     | <i>Brady</i> , 1884. Report 'Challenger,' p. 539, pl. lxx, figs. 3 a, b.   |
| —                        | —                     | <i>de Amicis</i> 1895. <i>Naturaliste Sicil.</i> , vol. xiv, pp. 39 and 62.  |

*Characters*.—One of the compressed, long-ovate *Cristellariæ*, nearly straight on one edge nearest to the umbilicus; and boldly curved on the other, which has a crest of variable proportions. Chambers well defined, subtriangular, and gently curved.

*Occurrence*.—In the North Atlantic at 300 to 1000 fathoms; South Atlantic at 1900 fathoms, South Pacific at 150—1100 fathoms, and North Pacific at 2050 fathoms. In the fossil state it is known from the Eocene (London Clay); Miocene of Hungary, Vienna, and Malaga; and Pliocene of Garrucha, South Spain.

The specimens from the Crag belong to zone f at Sutton.

*Sub-family 3.—POLYMORPHININÆ.*

*Brady, Report 'Challenger,' 1884, pp. 70 and 557.*

*General Characters.*—Segments arranged spirally or irregularly round the long axis; rarely biserial and alternate.

*Genus 1.—POLYMORPHINA, d'Orbigny, 1826.*

*Brady, Report 'Challenger,' 1884, pp. 70 and 557.*

*Polymorphum.*—*Soldani.*

*SERPULA.*—*Walker and Jacob, Kanmacher.*

*VERMICULUM.*—*Montagu, Fleming, Macgillivray.*

*ARETHUSA.*—*Montfort, Bowdich, Fleming, Thorpe.*

*MISILUS.*—*De Montfort.*

*CANTHARUS.*—*De Montfort.*

*POLYMORPHINA.*—*D'Orbigny, Sander Rang, Menke, Ehrenberg, Römer, Macgillivray, Morris, Searles Wood, Philippi, Bronn, Pictet, Reuss, Strickland, Alth, Morris and Jones, Parker and Jones, Egger, Williamson, Terquem, Karrer, Carpenter, von Gümbel, Brady, Stache, Dittmar, Sars, Schwager, Alcock, Bunzel, von Schlicht, von Hantken, Olszewski, Costa, Dunikowski, Berthelin, von Münster, Basset, Blake, Häusler, Bornemann, Zittel, Dawson, Toulà, Andreæ, Bütschli, Sherborn, Burrows, Bailey, Deecke, Marsson, Schultze, Walther, Ansted, Chapman, Crick, Goës, Chimmo, Green, Folin, Millett, De Amicis, Fornasini, Guppy, Wisniowski, Mariani, von Hantken, and others.*

*GLOBULINA.*—*D'Orbigny, Sander Rang, Römer, von Münster, Bronn, Pictet, von Gümbel, Reuss, Alth, Terquem, Morris, Jones, Bornemann, Egger, Karrer, Schwager, von Schlicht, Zwingli, Kübler.*

*GUTTULINA.*—*D'Orbigny, Sander Rang, Römer, Ehrenberg, Bronn, Pictet, Reuss, Costa, Gümbel, Alth, Morris, Jones, Bornemann, Egger, Karrer, Ansted, Stache, von Schlicht, Terquem, Brady, Parker, Berthelin.*

*PYRULINA.*—*D'Orbigny, Sander Rang, Reuss, Morris and Jones, Ehrenberg, von Schlicht.*

*RENOIDEA.*—*Brown.*

*RAPHANULINA.*—*Zborezewski.*

*OPIOPTERINA.*—*Zborezewski.*

*PROPOPORUS.*—*Ehrenberg, Reuss.*

*AULOSTOMELLA.*—*Alth, Pictet.*

*BIGENERINA.*—*Ehrenberg.*

*PLEURITES.*—*Ehrenberg, Kübler and Zwingli.*

*ROSTROLINA.*—*Von Schlicht.*



*General Characters.*<sup>1</sup>—Bi- or tri-serial or irregularly spiral; aperture central, terminal, round, and radiate, sometimes fissurine or porous; surface smooth or ornamented. Usually free, sometimes adherent.

*Polymorphina* has been found fossil in the Triassic (Raibl) strata of South Germany, the Lias, and the successive Mesozoic and Cainozoic formations; and its distribution is world-wide at the present time.

1. POLYMORPHINA LACTEA (*Walker and Jacob*), 1789. Plate I, fig. 48.

Part I, 1866, Appendices I and II, Tables, No. 48.

- Serpula tenuis ovalis lævis*, *Walker and Jacob*, 1784. Test. Min., p. 2, pl. i, fig. 5.  
*Polymorpha subcordiformia* vel *oviformia*, *Soldani*, 1791. Testaceogr., vol. i, pt. 2, p. 114, pl. cxii, fig. gg.  
 SERPULA LACTEA, *Walker and Jacob* (fide *Kanmacher*), 1798. Adams's Essays, 2nd edit., p. 634, pl. xiv, fig. 4.  
 VERMICULUM LACTEUM, *Montagu*, 1803. Test. Brit., p. 522.  
 — — — *Fleming*, 1822. Wern. Mem., vol. iv, p. 566, pl. xv, fig. 6.  
 POLYMORPHINA (GLOBULINA) OVATA, *d'Orbigny*, 1826. Ann. Sc. Nat., vol. vii, p. 266, No. 22.  
 ARETHUSA ? LACTEA, *Fleming*, 1828. Hist. Brit. Animals, p. 234.  
 GLOBULINA CARIBÆA, *d'Orb.*, 1839. Foram. Cuba, p. 135, pl. ii, figs. 7, 8.  
 GUTTULINA PLANCII, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 60, pl. i, fig. 5.  
 RENOIDEA OBLONGA, *Brown*, 1844. Illustr. Recent Conch., p. 3, pl. lvi, figs. 16, 17 (in 1st edit., 1827, pl. i, figs. 16, 17).  
 POLYMORPHINA LACTEA, *Macgillivray*, 1843. Moll. Aberdeen, p. 320.  
 — (GLOBULINA) LACHRYMA, *Reuss*, 1845. Verstein. böhm. Kreid., pt. 1, p. 40, pl. xii, fig. 6; pl. xiii, fig. 83; and pt. 2, 1846, p. 110.  
 GLOBULINA LACHRYMA, *Alth*, 1850. Haidinger's Abhandl., vol. iii, p. 363, pl. xiii, fig. 16.  
 — — — *Reuss*, 1851. Ibid., vol. iv, p. 43, pl. v (iv in text), fig. 9.

<sup>1</sup> For details as to the history and affinities of this genus the reader is referred to the "Monograph of the Genus Polymorphina," 'Trans. Linn. Soc.,' vol. xxvii, 1870, pp. 197—253. The critical examination of the Foraminifera depicted in Ehrenberg's 'Mikrogeologie' not having been completed when this Monograph was published in 1870, several inaccuracies were introduced; and certain errors should be corrected, as noticed in the 'Ann. Mag. Nat. Hist.,' ser. 4, vol. ix, 1872, p. 298. Thus—at p. 213 delete *Strophoconus ovum*, *spicula*, and [*Grammostomum*] *laxum*; at p. 219, *Strophoconus stiliger* and *acanthopus*; at p. 220, *Grammostomum turio*; at p. 223, *Strophoconus Hemprichii*; at p. 224, *Sphæroidina Parisiensis*; at p. 227, the 1st, 2nd, 3rd, 5th, 6th, 8th to the 16th, and the 19th of Ehrenberg's species; and add *Loxostomum vorax*, pl. xxviii, fig. 24; at p. 232 delete *Polymorphina asparagus* and *turio*, *Sagrina longirostris*, and *Vaginulina obscura*; at p. 233, *Vaginulina paradoxa*; at p. 234, *Polymorphina nucleus*; at p. 238, *Grammostomum costulatum*; at p. 242 add, under *Globulina tuberculata*, *Proroporus verrucosus*, pl. xxix, fig. 19.

- PYRULINA OVULUM, *Ehrenberg*, 1854. Mikrogeologie, pl. xxxi, figs. 35, 36.  
 POLYMORPHINA LACTEA, *Jones*, 1854. Morris's Catal. Brit. Foss., edit. 2, p. 40.  
 — MÜNSTERI, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii,  
     p. 249, pl. viii, fig. 80.  
 — OVULUM, *Idem*, 1855. Ibid., p. 250, pl. viii, fig. 83.  
 GLOBULINA ROEMERI, *Idem*, 1855. Ibid., p. 245, pl. vi, fig. 63.  
 GUTTULINA DEFORMATA, *Idem*, 1855. Ibid., fig. 64.  
 — TURGIDA, *Idem*, 1855. Ibid., p. 246, pl. vi, fig. 66.  
 POLYMORPHINA LACTEA (typica in parte), *Williamson*, 1858. Rec. Foram. Gt.  
     Brit., p. 70, pl. vi, fig. 147.  
 — — var. COMMUNIS, *Idem*, 1858. Ibid., p. 72, pl. vi, figs.  
     153—155.  
 — — [varieties], *J. W. Dawson*, 1859. Canad. Nat., vol. iv,  
     p. 28, figs. 2, 3.  
 GUTTULINA DILUTA, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Gesell., vol. xii,  
     p. 160, pl. vi, figs. 11 a—c.  
 POLYMORPHINA LACTEA, *Parker and Jones*, 1860. Quart. Journ. Geol. Soc., vol.  
     xvi, p. 454, pl. xx, fig. 44;  
     and p. 302, Table.  
 — — — 1862. Carpenter's Introd. Foram.,  
     p. 311.  
 — — (typica), *Alcock*, 1865. Proc. Lit. Phil. Soc., Manchester,  
     vol. iv, p. 206.  
 — — — *Sars*, 1865. Foss. Dyrelevn. fra Kvartærperiod.,  
     pp. 55, 62, 65, 68, 85, 91.  
 — — *J., P., and B.*, 1866. Monogr. For. Crag, Appendices,  
     Tables, No. 48, pl. i, fig. 48.  
 — TUBULOSA (part <sup>1</sup>), *Idem*, 1866. Ibid., Nos. 54, 55, pl. i, figs. 74, 75.  
 — LACTEA, *Brady*, 1868. Trans. Geol. Soc. Glasgow, vol. iii, p. 125.  
 — — *Sars*, 1868. Vidensk.-Selsk. Forhandl. for 1868, p. 248.  
 — — *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist.,  
     ser. 4, vol. vi, p. 306.  
 GUTTULINA, No. 491, *Schlicht*, 1870. Foram. Pietzpuhl, p. 84, pl. xxxii, figs. 21,  
     22 ("Polymorphina sororia," *Reuss*,  
     Sitzungs. k. Akad. Wien, vol. lxii, 1870,  
     p. 487).  
 POLYMORPHINA LACTEA, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc.,  
     vol. xxvii, p. 213, pl. xxxix, figs. 1 a—c.

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<sup>1</sup> The tubulose *Polymorphinæ* in pl. i, 1866 (see also further on, p. 255), are probably—  
 Fig. 69, *Polymorphina Soldanii*, d'Orb., striate variety. | Fig. 71, *Polymorphina rotundata*, Bornemann.  
 „ 70, „ communis, d'Orb. | „ 72 and 73 „ gibba, d'Orb.  
 „ 74 and 75 „ lactea, W. and J.

A memoir on the tubulose *Polymorphinæ*, of which there are sixty-nine known forms, has lately been communicated to the Linnean Society by T. R. Jones and F. Chapman. They define five groups, namely: (1) with "apical" growths (divisible into five sub-groups,—formæ *damæcornis*, *coronula*, *acuplacentia*, *horrida*, et *racemosa*); (2) "subapical" growths (forma *circularis*); (3) "on general surface" (forma *diffusa*); (4) "marginal" (forma *marginalis*); (5) "mixed kinds of growths" (forma *complicata*).

- POLYMORPHINA LACTEA, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, pp. 170, 171, No. 64, pl. xi, fig. 104 (after Soldani).
- GUTTULINA DISPARILIS, *Terquem*, 1874. Foram. Syst. Oolithique, p. 309, pl. xxxiii, fig. 23.
- POLYMORPHINA MUENSTERI, *Hantken*, 1875. Mitth. Jahrb. k. Ungar. geol. Anst., p. 61, pl. vii, fig. 16.
- LACTEA, *Terquem*, 1875. Plage Dunkerque, p. 37, pl. v, fig. 12.
- GUTTULINA COMMUNIS, *Idem*, 1875. Ibid., fig. 13.
- POLYMORPHINA LACTEA, *Brady and Robertson*, 1875. Report Brit. Assoc. for 1874, p. 190.
- — *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
- BUCCULENTA, *Berthelin*, 1880. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 58, pl. xxvii, figs. 16, 17.
- GLOBULINA VARIANS, *Terquem*, 1882. Ibid., ser. 3, vol. ii, p. 128, pl. xiii, figs. 9, 15.
- POLYMORPHINA LACTEA, *Brady*, 1884. 'Challenger' Report, p. 559, pl. lxxi, figs. 11, 14, and fistulose form, p. 560, pl. lxiii, fig. 14.
- — *Gümbel*, 1885. Geol. Bayern, Theil 1, Lief 2, p. 421, cut 266, fig. 15.
- OOLITHICA, *Deecke*, 1886. Mém. Soc. d'Emul. Montbéliard, vol. xvi, p. 37, pl. i, fig. 28.
- aff. AMYGDALOIDES, *Deecke*, 1886. Ibid., figs. 20, 20 a.
- BILOCULARIS, *Deecke*, 1886. Ibid., vol. xvi, p. o, pl. i, fig. 11.
- LACTEA, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 224, pl. xlv, fig. 11 (?).
- — & var. ELONGATA, *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Micr. Soc., p. 561, pl. xi, figs. 9, 10 (?).
- — *Crick and Sherborn*, 1892. Journ. Northamp. Nat. Hist. Soc., vol. vii, p. 71, fig. 25.
- — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. ii, p. 308, pl. ix, figs. 8, 14, 15.
- ? ELEGANTISSIMA, *Idem*, 1893. Ibid., fig. 16.
- LACTEA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 54.
- — *Chapman*, 1896. Journ. R. Micr. Soc., p. 9, pl. ii, figs. 3, 4.

*Characters*.—Shell (typical) ovate, gibbous, slightly asymmetrical; anterior extremity acute; posterior obtuse, rounded. Chambers few, oblong, oblique, somewhat inflated.

The shell of *P. lactea* has normally four or five visible chambers, sufficiently ventricose to disturb the regularity of the general outline; the sutural lines marked by slight depression. In its typical form the transverse section is nearly circular; but this is a variable character, and the compressed modifications described by



Prof. Reuss under the name of *Globulina amygdaloides* may be taken as representing a subvarietal condition.

*Occurrence.*—*Polymorphina lactea* is a cosmopolitan species, and has a wide bathymetrical range, although it is most at home in the comparatively shallow waters of temperate latitudes. Specimens obtained from great depths are rare and poorly developed. The geological range of the species extends to the Kimeridge Clay and the Portland Limestone of Dorsetshire (Parker and Jones). *Polymorphina lactea* has been found by Mr. Charles Moore in a Jurassic marly limestone from Queensland, Australia ('Quart. Journ. Geol. Soc.,' vol. xxvii, pp. 236, 239). It has also been found in the Cretaceous of Bohemia and Russia, in the Gault of Folkestone, and in the Red Chalk of Speeton; in the Lower and Middle Tertiaries of Northern and Central Germany; in the Miocene of Piedmont and of Muddy Creek, Victoria; and in the Pliocene of St. Erth.

We have specimens in our own collections from the Casterlian and Scaldisian of Antwerp; and it is found commonly in Pleistocene deposits. In the Coralline Crag we have met with it in every zone examined. It has also been found in the Red Crag of Essex, in the fluvio-marine beds of Southwold and Thorpe, and in the Chillesford beds.

## 2. POLYMORPHINA GIBBA,<sup>1</sup> d'Orbigny, 1826. Plate I, figs. 49—51.

Part I, 1866, Appendices I and II, Tables, No. 49.

*Polymorpha Subcordiformia* vel *Oxiformia*, *Soldani*, 1791. *Testaceographia*, vol. i, pt. 2, p. 114, pl. cxiii, figs. 22, c.

GLOBULINA GIBBA, d'Orbigny, 1826. *Ann. Sci. Nat.*, vol. vii, p. 266, No. 20; *Modèle*, No. 63.

— — *S. V. Wood*, 1843. *Morris's Catal. Brit. Foss.*, p. 62.

— GLOBOSA, *Reuss*, 1845. *Verst. böhm. Kreide*, p. 40, pl. xiii, fig. 82.

— GIBBA, *Reuss*, 1846. In *Geinitz's Grundriss*, &c., p. 669, pl. xxiv, fig. 84.

— GLOBOSA, *Reuss*, 1846. *Ibid.*, p. 669, pl. xxiv, fig. 85.

— GIBBA, d'Orb., 1846. *Foram. Foss. Wien*, p. 227, pl. xiii, figs. 13, 14.

<sup>1</sup> Gradations and varieties of *Polymorphina*, including several so-called "species," namely, *P. lactea*, *gibba*, *gutta*, *fusiformis*, *Burdigalensis*, *compressa*, are comprised in Beissel's 'Foram. Aach. Kreid.,' 1891, pl. xi, figs. 1—56, and pl. xii, figs. 1—8, under the name *P. proteus*, Beissel. Figs. 9—16 in pl. xii, under the same name, is a *Ramulina*.

Mr. Millett informs us that *A. Silvestri*, in the "Atti e Rendiconti dell' Accad. de Sci. Lettere e Arti dei Zelanti," &c., vol. v, 1893, at page 12, under the name of *Bulimina pyrula*, d'Orb., refers to several figures on pl. v, which may be ascribed to *Polymorphina communis*, *problema*, *gibba*, &c.

## FORAMINIFERA OF THE CRAG.

- GLOBULINA PUNCTATA, *d'Orb.*, 1846. Ibid., p. 229, pl. xiii, figs. 17, 18.
- GIBBA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Ges., vol. iii, p. 80.
- AMPLECTENS, *Reuss*, 1851. Ibid., p. 81, pl. vi, fig. 44.
- INFLATA, *Reuss*, 1851. Ibid., fig. 45.
- POLYMORPHINA GIBBA, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 283, pl. xi, fig. 32.
- (GUTTULINA) GIBBA, var.  $\alpha$ , *VERA*, *Egger*, 1857. Neues Jahrb., &c., p. 289, pl. xiii, figs. 1—4.
- — — var.  $\beta$ , OVOIDEA, *Egger*, 1857. Ibid., figs. 5—7.
- — — var.  $\gamma$ , SUBGIBBA, *Egger*, 1857. Ibid., figs. 8—10.
- — — var.  $\delta$ , PYRULA, *Egger*, 1857. Ibid., p. 290, pl. xiii, figs. 11, 12.
- GIBBA, *J., P., and B.*, 1866. Monogr. For. Crag, p. 74, No. 49, pl. i, figs. 49—51.
- GLOBULINA AMPLECTENS, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Ges., vol. xii, p. 160, pl. vi, figs. 12 *a—c*.
- POLYMORPHINA LACTEA, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 359, pl. xiii, figs. 45, 46.
- GIBBA, var. ORBICULARIS, *Karrer*, 1868. Sitz. Akad. Wiss. Wien, vol. lviii, p. 174, pl. iv, fig. 8.
- GLOBULINA SUBGIBBA, *Gümbel*, 1868. Abhandl. k. bayer. Akad. Wiss., vol. x, Abth. 11, p. 645, pl. ii, fig. 79.
- No. 425, *Schlicht*, 1870. Foram. Pietzpuhl, p. 75, pl. xxvi, figs. 31—34 (not named by Reuss).
- No. 427 and No. 428, *Schlicht*, 1870. Ibid., pl. xxvii, figs. 1—3, and 4—6 (“*Polymorphina gibba*,” Reuss, ‘Sitzungsb. k. Akad. Wien,’ vol. lxii, 1870, p. 485).
- No. 429 and No. 431, *Schlicht*, 1870. Ibid., figs. 7—9 and 10—12 (“*Polymorphina amygdaloides*,” Reuss, ibid., p. 486).
- ROSTROLINA, No. 415, *Schlicht*, 1870. Ibid., p. 73, pl. xxvi, figs. 25—27 (“*Polymorphina inflata*,” Reuss, ibid., p. 485).
- POLYMORPHINA GIBBA, and var. EQUALIS. *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, pp. 216, 251, pl. xxxix, figs. 2 *a—d*.
- — *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 190.
- GLOBULINA GIBBA, *Terquem*, 1875. Plage Dunkerque, p. 38, pl. v, fig. 15.
- OVIFORMIS, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 44, pl. ix, figs. 9—12.
- GIBBA, *Terquem*, 1878. Ibid., p. 43, pl. ix, figs. 1—5.
- POLYMORPHINA GIBBA, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
- SUBSPHERICA, *Berthelin*, 1880. Mém. Soc. Géol. Fr., sér. 3, vol. i, p. 58, pl. xxvii, fig. 18.

- POLYMORPHINA (GLOBULINA) GIBBA, *Andreae*, 1884. Abhandl. geol. Special-Karte  
Elsass-Loth., pp. 209, 233,  
pl. ix, figs. 10—13.
- GIBBA, *Brady*, 1884. 'Challenger' Report, p. 561, pl. lxxi, fig. 12.
- (GLOBULINA) GIBBA, *Basset*, 1885. Ann. Soc. Sci. N. Char.-Inf.,  
No. 21, p. 161, fig. 63.
- GIBBA, *Sherborn and Chapman*, 1886. Journ. Roy. Microsc. Soc.,  
ser. 2, vol. vi, p. 755, pl. xvi,  
fig. 5.
- — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9,  
p. 55, pl. ix, figs. 522—526, vars. ?).
- — (forma FISTULOSA), *De Amicis*, 1895. Nat. Sicil., xiv, p. 45.
- — *Chapman*, 1896. Journ. R. Micr. Soc., p. 9, pl. ii, figs. 5, 6.

*Characters*.—Shell (typical) subspherical or oval, somewhat produced at the apex, broad and rounded at the base. Chambers few, compact, and overlapping. Sutures marked, not depressed.

*Polymorphina gibba* is perhaps as definite in typical characters, and as apt for technical description as any member of the group; still some latitude must be allowed in the terms employed for its diagnosis. D'Orbigny's 'Modèle,' No. 63, represents a nearly globular shell, and may be taken as representing the normal form. Our list of synonyms refers to specimens deviating in no striking particular from this standard.

The shape of the anterior portion of the shell differs considerably in different individuals. In some it is acuminate, and the orifice is situate in a mammillate protuberance; in others it is truncate, and the general aperture is flush with the body of the shell. In rare examples the orifice is turned inwards, like that of an Entosolenian *Lagena*.

A compressed variety sometimes occurs bearing a similar relation to *P. gibba* that *P. lactea*, var. *amygdaloides*, does to *P. lactea*; and of this d'Orbigny's *Globulina æqualis* is perhaps the best representative: its synonymy will be found in the Monograph of the genus, *op. cit.*, pp. 216, 217.

The leading features of the *tubulose forms* of the *Polymorphinæ* shown by figs. 70—75 in Plate I indicate *P. gibba* as one of their types. Fig. 71 leans towards *P. lactea*; and fig. 74 has a tendency to protrude one of its chambers, like *P. problema*, but not enough. As for the style of the outgrowths, fig. 70 has them *complicated*,—that is, both apical and subapical; fig. 71 seems to have had a flat apical mass giving off lateral branches,—*acuplacental*; figs. 72, 74, 75 had a very free-growing, branching (*racemose*), apical outgrowth; and fig. 73 had an extraneous growth both on the apex and general surface (*diffuse*); fig. 76 is evidently the exposed base of a *racemose*, or possibly of a *placental* (cake-like) growth.



*Occurrence.*—The geographical range of *Polymorphina gibba* is co-extensive with that of *P. lactea*. It has also a very extended geological range. It has been obtained from the Kimeridge Clay of England, and from the Cretaceous of Europe generally; and it is a common Tertiary Foraminifer, as will be seen by reference to the Table of Distribution in the Appendix. In the Pliocene it is recorded from the Diestian, Casterlian, and Scaldisian of Antwerp, from Italy, Garrucha, and St. Erth. In the Coralline Crag we have found it in nearly every zone examined.

3. POLYMORPHINA GUTTA, *d'Orbigny*, 1826. Plate I, figs. 46, 47.

Part I, 1866, Appendices I and II, Nos. 53, 54.

Polymorphum, *Soldani*, 1789. Testaceographia, vol. i, pt. 2, pl. cxxii, fig. *gg* (not referred to in the text).

PYRULINA GUTTA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 267, No. 28, pl. xii, figs. 5, 6; Modèle, No. 30.

POLYMORPHINA CLAVATA, *Römer*, 1838. Neues Jahrb., &c., p. 386, pl. iii, fig. 38.

PYRULINA GUTTA, *Reuss*, 1861. Model, Catal. 1861, No. 68; Catal. 1865, No. 96.

— — — — — *OBTUSA*, *Reuss*, 1862. Sitz. Akad. Wiss. Wien, vol. xlvi, p. 79, pl. ix, fig. 9.

POLYMORPHINA (PYRULINA) GUTTA, *Parker and Jones*, 1863. Ann. Mag. Nat. Hist., ser. 3, vol. xii, p. 440, No. 21.

— — — — — *P., J., and B.*, 1865. Ibid., vol. xvi, p. 24, pl. ii, fig. 51.

— — — — — *GUTTA, J., P., and B.*, 1866. Monogr. For. Crag, Appendix I, No. 53, pl. i, figs. 46, 47.

ROSTROLINA, No. 408, *Schlicht*, 1870. Foram. Pietzpuhl, p. 72, pl. xxvi, figs. 4—6 (= "*Polymorphina sororia*," *Reuss*, 'Sitzb. Ak. Wien,' vol. lxii, 1870, p. 487).

— — — — — No. 409, *Schlicht*, 1870. Ibid., figs. 1—3 (= "*P. lanceolata*," *Reuss*, *ibid.*).

— — — — — No. 411, *Schlicht*, 1870. Ibid., figs. 10—12 (= "*P. sororia*," *Reuss*, *ibid.*).

POLYMORPHINA GUTTA, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 218, pl. xxxix, fig. 3.

— — — — — *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 171, pl. xi, fig. 107.

— — — — — (PYRULINA) GUTTA, *Basset*, 1885. Ann. Soc. Sci. Nat. Char.-Inf. for 1884, p. 161, fig. 30.

— — — — — *GUTTA, Sherborn and Chapman*, 1886. Journ. R. Microsc. Soc., ser. 2, vol. vi, p. 755, pl. xvi, fig. 6.

— — — — — — — — — *Chapman*, 1896. Ibid. for 1896, p. 10, pl. ii, figs. 7, 8.

*Characters*.—Shell ovate-elongate, symmetrical, pyriform; anterior portion tapering, acuminate; posterior obtuse, rounded; margin entire, septal lines not depressed. Chambers elongate, closely embracing, arranged triserially.

*Polymorphina gutta*, in good specimens, presents tolerably definite characters, its triserial arrangement, closely embracing chambers, and circular transverse section being sufficient for ordinary diagnosis. Its long, tapering upper extremity and numerous chambers distinguish it from *P. gibba*, and the rounded base and compact spiral build from its nearest ally, *Polymorphina (Pyrulina) acuminata*, d'Orb.

*Occurrence*.—*Polymorphina gutta* has not hitherto been recorded in the recent condition. It is best known as a Tertiary fossil, but has been found in the Hils Clay (Neocomian) of Germany, in the English (Bargate) Beds of similar age, and in the Gault of Folkestone. Specimens have been recorded from the Eocene (London Clay and Barton Beds), from the Oligocene of Pietzpuhl, and from the Upper Tertiaries of North Italy.

We have nothing to add to the record given in the six columns of the Table, and Appendix II, Part 1, 1866, so far as the occurrence in the Crag is concerned.<sup>1</sup>

#### 4. POLYMORPHINA SORORIA, *Reuss*, 1863. Plate VI, figs. 13 *a*, *b*.

POLYMORPHINA (GUTTULINA) SORORIA, <i>Reuss</i> , 1863.	Bull. Acad. Roy. Belg., sér. 2, vol. xv, p. 151, pl. ii, figs. 25—29.
— — — —	1864. Sitzungsber. k. Akad. Wien, vol. xlviii, pp. 57 and 67, pl. vii, figs. 72—74.
— — — —	1870. Ibid., vol. lxii, p. 487, No. 9.
VULVULINA MINUTISSIMA (?), <i>Zwingli and Kübler</i> , 1870.	Foram. Schweiz. Jura, p. 30, pl. iii, fig. 42.
— EICHBERGENSIS (?), <i>Zwingli and Kübler</i> , 1870.	Ibid., figs. 43, 43 <i>a</i> .
POLYMORPHINA SORORIA, <i>Brady</i> , 1884.	'Challenger' Report, p. 562, pl. lxxi, figs. 15, 16; pl. lxxiii, fig. 15.
— — — —	<i>Walther</i> , 1888. Mitth. Neapol., vol. viii, p. 382, pl. xx, fig. 4.

<sup>1</sup> We have, however, grave doubts as to the occurrence of *P. gutta* in the Crag. We are inclined to think that figs. 46 and 47, pl. i, might be more correctly described as *P. lactea*. Unfortunately no edge views are given.

Although stated in Part 1 of the Monograph to be very common, we have not been able to find one specimen in our own sortings.—H. W. B. and R. H.

POLYMORPHINA SORORIA (?), *Egger*, 1893. Abhandl. k. Akad. Bayer., vol. xviii, Abth. 2, p. 308, pl. ix, fig. 20.

— — *Chapman*, 1896. Journ. R. Micr. Soc., p. 12, pl. ii, figs. 11, 12.

*Characters*.—More or less oviform and compressed, sometimes subfusiform; suboval in transverse section; broad about the middle, rounded below, obtusely pointed above. Five or six chambers, variable in size, irregularly subspiral. This form is nearly allied to the typical *P. communis*.

*Occurrence*.—*Polymorphina sororia* is stated in the 'Challenger' Report to have been found at two stations in the North Atlantic, west of Ireland, at depths of 808 and 1443 fathoms; also midway between Cape of Good Hope and Kerguelen Island (1375 fathoms). It was also found by the 'Gazelle' off Sierra Leone, at a depth of 367 fathoms (*Egger*).

As a fossil it has been recorded from the Chalk of Taplow; from the Oligocene of Elsass and Pietzpuhl; and from the Pliocene of Belgium and St. Erth. The Crag specimens were obtained from Broom Hill (zone **d**) and Aldborough (zone **g**).

5. POLYMORPHINA COMPRESSA, *d'Orbigny*, 1846. Plate I, figs. 54, 65, 77—80; and (distorted) Plate V, figs. 26 and 28.

Part I, 1866, Appendices I and II, Tables, Nos. 55, 56.

*Orthoceras tuberosum*, *Soldani*, 1791. Testaceographia, vol. i, pt. 2, p. 99, pl. cvii, fig. *kk*.

*Polymorpha Subovalia*, *Soldani*, 1791. Ibid., p. 114, pl. cxiv, *F*; pl. cxv, *N*; pl. cxvi, *X*.

POLYMORPHINA TUBEROSA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 265, No. 6 (ref. *Soldani*, cvii, *kk*; bad figure).

— COMPRESSA, *d'Orb.*, 1846. For. Foss. Wien, p. 233, pl. xii, figs. 32—34.

— ACUTA, *d'Orb.*, 1846. Ibid., p. 234, pl. xiii, figs. 4, 5; pl. xiv, figs. 5—7.

GUTTULINA ELLIPTICA, *Reuss*, 1846. Verst. böhm. Kreide, p. 110, pl. xxiv, fig. 55.

— — *Alth*, 1850. Haidingers Naturwiss. Abhandl., vol. iii, p. 262, pl. xiii, fig. 15.

POLYMORPHINA INSIGNIS, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 248, pl. vii, figs. 74, 75.

— SUBDEPRESSA, *Reuss*, 1855. Ibid., p. 249, pl. viii, fig. 81.

— CRASSA, *Reuss*, 1855. Ibid., p. 250, pl. viii, fig. 82.



- POLYMORPHINA INCERTA, *Egger*, 1857. Neues Jahrb., &c., p. 286, pl. xiii, figs. 19—21.
- MEDIA, *Egger*, 1857. Ibid., p. 287, pl. xiii, figs. 28, 29.
- LACTEA, *Williamson*, 1858. Rec. Foram. Gt. Britain, p. 70, pl. vi, figs. 145, 146.
- GLOBULINA DISCRETA, *Reuss*, 1864. Sitz. k. Akad. Wiss. Wien, vol. 1, p. 468, pl. iii, fig. 3.
- ROBUSTA, *Reuss*, 1864. Ibid., p. 470, pl. iii, figs. 5—7.
- POLYMORPHINA ANGUSTATA, *Terquem*, 1864. 4me Mémoire Foram. Lias, p. 296, pl. xii, figs. 33—35.
- PYRIFORMIS, *Terquem*, 1864. Ibid., p. 298, pl. xii, figs. 41—43.
- SINUATA, *Terquem*, 1864. Ibid., fig. 48.
- INCAVATA, *Stache*, 1865. Novara-Reise, Geol. Theil, vol. i, p. 260, pl. xxiv, fig. 7.
- SACCULUS, *Stache*, 1865. Ibid., p. 259, pl. xxiv, fig. 6.
- PYGMÆA, *Schwager*, 1865. Württ. Naturwiss. Jahreshefte, vol. xxi, p. 138, pl. vii, fig. 8.
- LACTEA, var. COMPRESSA, *Parker and Jones*, 1865. Phil. Trans. vol. clv, p. 361, pl. xiii, figs. 47, 49—51.
- COMPRESSA, *J., P., and B.*, 1866. Mon. For. Crag, App., Nos. 55 and 56, pl. i, figs. 54, 65, 77—80.
- SEMITECTA, *Reuss*, 1867. Sitz. k. Akad. Wiss. Wien, vol. lv, p. 91, pl. iii, fig. 10.
- ZEUSCHNERI, *Reuss*, 1867. Ibid., p. 90, pl. iv, fig. 1.
- COMPRESSA, *Brady*, 1867. Proc. Somerset. Arch. Nat. Hist. Soc. vol. xiii, p. 230, pl. iii, fig. 50.
- No. 495 and No. 496, *Schlicht*, 1870. Foram. Pietzpuhl, p. 85, pl. xxxii, figs. 29—32, and figs. 35—38 ("Polym. Humboldti, Bornemann," according to Reuss).
- COMPRESSA, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.
- VULVULINA EICHBERGENSIS, *Zwingli and Kübler*, 1870. Foram. schweiz. Jura., p. 30, pl. iii, fig. 43.
- POLYMORPHINA COMPRESSA, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 227, pl. xl, fig. 12.
- — — *P., J., and B.*, 1871. Ann. and Mag. Nat. Hist., ser. 4, vol. viii, p. 170, No. 62, pl. ii, fig. 105.
- PYRIFORMIS, *Terquem*, 1874. For. Syst. Oolithique, p. 302, pl. xxxiii, fig. 2.
- AMYGDALA, *Terquem*, 1874. Ibid., p. 301, pl. xxxii, figs. 28—30.
- POLYGONA, *Terquem*, 1874. Ibid., p. 304, pl. xxxiii, figs. 8, 11, 14.
- DISJUNCTA, *Terquem*, 1874. Ibid., p. 303, pl. xxxiii, fig. 3.
- ANNULATA, *Terquem*, 1874. Ibid., p. 304, pl. xxxiii, figs. 5, 6.
- POLYGONA, *Terquem and Berthelin*, 1875. Mém. Soc. Géol. Fr., ser. 2, vol. x, pp. 66, 70, pl. xvi, fig. 3.

- GUTTULINA LIASINA, *Terquem and Berthelin*, 1875. Mém. Soc. Géol. Fr., ser. 3, vol. x, p. 70, pl. xvi, fig. 4.
- POLYMORPHINA COMPRESSA, *Brady*, 1875. Rep. Brit. Assoc. for 1874, p. 190.
- LACTEA, *Terquem*, 1876. Dunkerque, p. 79, pl. x, figs. 19, 20.
- COMPRESSA, *Blake*, 1876. Yorkshire Lias, p. 470, pl. xvii, fig. 32.
- BURDIGALENSIS, *Blake*, 1876. Ibid., p. 471, pl. xvii, fig. 36.
- SCHWAGERI, *Karrer*, 1877. Abhandl. k. k. geol. Reichsanstalt, vol. ix, p. 384, pl. xiv b, fig. 43.
- GIGAS, *Karrer*, 1877. Ibid., fig. 44.
- COMPRESSA, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
- AMYGDALOIDES, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, p. 39, pl. viii, fig. 26.
- UNDULOSA, *Terquem*, 1878. Ibid., p. 41, pl. viii, figs. 35, 36.
- FISCHERI, *Terquem*, 1878. Ibid., fig. 37.
- AMYGDALOIDES, *Terquem*, 1882. Ibid., vol. ii, p. 141, pl. xxii, figs. 30, 31.
- AMYGDALA, *Deecke*, 1884. Abhandl. geol. Specialkarte Elsass-Loth., p. 56, pl. ii, fig. 19.
- COMPRESSA, *Brady*, 1884. 'Challenger' Rep., p. 565, pl. lxxii, figs. 9—11; *fistulose*, p. 556, pl. lxxiii, fig. 17.
- aff. AMYGDALA, *Deecke*, 1886. Mém. Soc. Emul. Montbéliard, vol. xvi, p. 37, pl. i, fig. 20.
- POLYGONA, *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. vi, p. 63, pl. xiii, fig. 18.
- LACTEA, *Dawson*, 1886. Handbook Zoology, p. 44, fig. 34.
- COMPRESSA, *Brady*, 1887. Journ. Roy. Micr. Soc., p. 914.
- — *Mariani*, 1888. Boll. Soc. Geol. Ital., vol. vii, p. 288, pl. x, fig. 13.
- COMMUNIS (?), *Burrows, Sherborn, and Bailey*, 1890. Journ. Roy. Microsc. Soc., p. 561, pl. xi, fig. 11.
- EICHBERGENSIS, *Wisniowski*, 1890. Mem. Acad. Sci. Cracow, vol. xvii, p. 52, pl. x, fig. 25.
- LIASICA, *Mariani*, 1891. Boll. Soc. Geol. Ital., vol. x, p. 729, pl. i, fig. 20.
- COMPRESSA, *Egger*, 1893. Abhandl. bayer. Akad., vol. xviii, p. 309, pl. ix, figs. 11—13.
- — *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 58, pl. x, figs. 539—553.
- — *Chapman*, 1896. Journ. Roy. Micr. Soc., p. 14, pl. ii, fig. 16.

*Note.*—D'Orbigny's name "*compressa*" has been generally adopted, because the possibly similar form "*tuberosa*" is based on a bad figure.

*Characters.*—Shell oblong, inequilateral, compressed, more or less fusiform. Chambers numerous, arranged in two unequal series, somewhat inflated. Septal lines depressed. Surface smooth. Aperture variable, usually simple, circular, and coronate, sometimes labyrinthic or porous.

A somewhat indefinite biserial arrangement, in which the segments appear irregularly opposed to each other rather than in alternation, together with the rounded margins and constricted septa, are characters sufficient for general diagnosis. The difficulty in distinguishing attenuated specimens from those of *P. cylindroides* is confessedly great; but the less compressed contour of the latter, its few chambers, and their erect position, will usually serve the purposes of the systematist.

A specimen of irregular growth is shown by fig. 26, Pl. V. It is so much encrusted with carbonate of lime that it presents a false resemblance to *P. variata*.

*Occurrence.*—*Polymorphina compressa* has a wide range, but is most common in the comparatively shallow waters of temperate latitudes. It has been found as far north as Smith Sound and Novaya Zemlya; also in the tropical South Atlantic and the North and South Pacific. It mostly affects shallow water, but specimens have been found at depths of from 400 to 600 fathoms.

In the fossil condition *P. compressa* has been recorded from the Lower and Middle Lias of the north part of France, and from the Middle and Upper Lias of Somerset. It has been found also in the Lower Oolite of Somerset; in the Oxford and Kimeridge Clays; in the Cretaceous of England, France, Germany, and North America. We have not observed any records from Eocene deposits; but it has been recorded from the Oligocene of Germany, from the Miocene of Vienna and Muddy Creek (Victoria), from the Pliocene of Belgium and St. Erth, and from the Pleistocene of Norway and the West of Scotland. In the Crag we have met with it in every zone examined.

#### 6. POLYMORPHINA THOUINI, *d'Orbigny*, 1826. Plate I, fig. 59.

POLYMORPHINA THOUINI, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 265, No. 8, Modèle, No. 23.

BIGENERINA CRETÆ, *Ehrenberg*, 1854. Mikrogeologie, pl. xxviii, fig. 21.

— ACANTHOPHORA, *Ehrenberg*, 1854. Ibid., pl. xxviii, fig. 22.

PROPOPORUS CRETÆ, *Ehrenberg*, 1854. Ibid., pl. xxvii, fig. 29; and pl. xxviii, fig. 20.

— SICULUS, *Ehrenberg*, 1854. Ibid., pl. xxvi, fig. 18.

POLYMORPHINA PUPIFORMIS, *Terquem*, 1864. Foram. Lias, 4e Mém., p. 300, pl. xiii, figs. 23, &c.

— THOUINI, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 22, pl. ii, fig. 49.

— — *J., P., and B.*, 1866. Monogr. Foram. Crag, App. I and II, Tables, No. 50, pl. i, fig. 59.

— — *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 232, pl. xl, fig. 17.



GUTTULINA, No. 466, *Schlicht*, 1870. Foram. Pietzpuhl, p. 81, pl. xxv, figs. 13, 14 (= *P. lanceolata*, Reuss).

POLYMORPHINA PUPIFORMIS, *Terquem*, 1874. Foram. Syst. Oolithique, 4e mém., p. 303, pl. xxxiii, fig. 4 (near *P. compressa*).

— THOUINI, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, pp. 48 and 54.

— — *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 142, pl. xxii, fig. 33.

— — *Brady*, 1884. 'Challenger' Report, p. 567, pl. lxxii, fig. 18.

— — *Basset*, 1885. Ann. Soc. Sci. Char.-Inf., No. 21, p. 161, fig. 23.

— PUPIFORMIS, *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. iv, p. 63, pl. xiii, fig. 19.

— THOUINI, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 59, pl. x, figs. 557, 558.

*Characters*.—Shell attenuate, subcylindrical, slightly constricted at the septal lines. Anterior extremity acute; posterior rounded. Chambers elongate, oblique, erect, slightly ventricose.

Of the very long, many-chambered *Polymorphinæ*, perhaps *P. Thouini* is the best-defined variety; yet the name does not appear to have been generally adopted by authors. It represents a longer, more cylindrical subtype than *P. fusiformis*, with a larger number of chambers and less oblique setting-on; indeed, it resembles more a much outdrawn specimen of *P. problema* than any other variety.

*Occurrence*.—*Polymorphina Thouini* is of rare occurrence in recent waters. The records given in the 'Challenger' Report are from the Levant (90 fathoms), and off East Moncœur Island, Bass Strait (38 fathoms). In a fossil condition the species is also somewhat rare. It has been obtained from the Lias (*Terquem*); from the Eocene (Calcaire-grossier) of the Paris Basin; from the Oligocene of Pietzpuhl; and from the Pliocene of Italy. In addition to the record for the Coralline Crag, given in Appendix II, Part I, we have specimens from Sudbourne Hall, zone **d**, and Broom Hill, zones **d** and **e**.

#### 7. POLYMORPHINA NODOSARIA, *Reuss*, 1864. Plate I, figs. 55—58 (*Dimorphina*).

Part I, 1866 (" *Dimorphina nodosaria*," in part), Appendix I, and Appendix II, Tables, No. 57.

POLYMORPHINA SUBNODOSA (?), *Reuss*, 1861. Sitz. k. Akad. Wiss. Wien, vol. xlii, p. 362, pl. ii, fig. 15.

- POLYMORPHINA NODOSARIA, *Reuss*, 1864. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 58, pl. vii, fig. 85.
- QUADRATA (in part), *Terquem*, 1864. Quatrième Mém. Foram. Lias, p. 296, pl. xii, figs. 27, &c.
- NODOSARIA, *Reuss*, 1866. Denkschr. k. Akad. Wissensch., vol. xxv, p. 155.
- DIMORPHINA NODOSARIA (part), *J., P., and B.*, 1866. Monogr. For. Crag, pl. i, figs. 55—58.
- POLYMORPHINA NODOSARIA, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xvii, p. 233, pl. xl, figs. 18 *a, b*.
- — *Blake*, 1876. Yorkshire Lias, p. 471, pl. xvii, fig. 34.
- SUBCYLINDRICA, *Hantken* (1875), 1881. Mitth. Jahrb. k. Ung. geol. Anstalt, vol. iv, p. 60, pl. xiv, fig. 14.

*Characters*.—Shell elongate, cylindrical, somewhat tapering; chambers four to eight, oblique, short, alternating.

*Occurrence*.—*Polymorphina nodosaria*, so far as is at present known, does not occur in recent seas. Fossil specimens have been obtained only from Tertiary deposits, namely the Middle Tertiaries of Central Germany and Hungary; and the Pliocene of Antwerp and St. Erth. In the Coralline Crag it has been met with only at Sutton.

#### 8. POLYMORPHINA CYLINDROIDES, *Roemer*, 1838. Plate VI, figs. 15 *a, b*.

- POLYMORPHINA CYLINDROIDES, *Roemer*, 1838. Neues Jahrb., &c., 1838, p. 385, pl. iii, fig. 26.
- — *Philippi*, 1844. Tertiärverstein. Nord-West Deutschl., p. 41.
- PROBOPORUS CYLINDROIDES, *Reuss*, 1845. Geinitz's Grundriss Verst., p. 678, pl. xxiv, fig. 80.
- POLYMORPHINA CYLINDROIDES, *Karsten*, 1849. Verzeichn. Rostock Verst. Steinberger Gestein, p. 8.
- — *Reuss*, 1855. Sitzungsab. k. Akad. Wiss. Wien, vol. xviii, p. 249, pl. viii, fig. 78.
- LACTEA, var. ACUMINATA, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 71, pl. vi, fig. 148.
- COMPRESSA (part), *Parker and Jones*, 1864. Phil. Trans., vol. clv, p. 361, pl. xiii, figs. 48 *a, b*.
- GUTTULINA, No. 471, *Schlicht*, 1870. Foram. Pietzpubl, p. 81, pl. xxxi, figs. 5, 6 ["*P. lanceolata*," *Reuss*, Sitz. Akad., 1870, p. 33].
- POLYMORPHINA CYLINDROIDES, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc. vol. xxvii, p. 221, pl. xxxix, figs. 6 *a—c*.
- — *Brady*, 1887. Journ. Roy. Micr. Soc., p. 914.

*Characters*.—Shell elongate, fusiform, more or less compressed; acuminate or subacuminate at the ends. Chambers elongate, in two parallel series, with slightly depressed sutures.

*Occurrence*.—*Polymorphina cylindroides* is not recorded in the 'Challenger' Report, nor in Egger's report on the voyage of the 'Gazelle.' It has been dredged off Skye by Mr. Barlee; also in some other northern localities.

The type-specimens were obtained by Count Münster from the Newer Tertiaries of North Germany. It has been figured by von Schlicht from the Oligocene of Pietzpuhl.

In the Crag we have specimens from Broom Hill, zone e, and Gedgrave, zone f.

#### 9. POLYMORPHINA CONCAVA, *Williamson*, 1857. Plate V, fig. 22.

POLYMORPHINA LACTEA, var. CONCAVA, *Williamson*, 1857. Rec. Foram. Great Britain, p. 72, pl. vi, figs. 151, 152.

— CONCAVA, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 236, pl. xl, fig. 22.

— — *Brady and Robertson*, 1875. Report Brit. Assoc. for 1874, p. 190.

— — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., No. 2, p. 54.

— — *Millett*, 1885. Rep. and Trans. Penzance Nat. Hist. and Antiq. Soc., p. 28.

— — *Brady*, 1887. Journ. Roy. Microsc. Soc., p. 914.

— — *Halkyard*, 1889. Rep. Manchester Microsc. Soc., p. 68.

*Characters*.—Shell oval or oblong, concave or flat on one face, somewhat convex on the other; chambers like those of *P. lactea* or *P. gibba*, bordered by a broad, irregular, thin flange; parasitical.

*Occurrence*.—*Polymorphina concava* is very rare in the recent condition. *Williamson's* specimens were obtained from Brixham, and we are not aware that it has been met with elsewhere than off our own coasts. A fossil specimen has been found in the Neocomian (Bargate beds) of Surrey. It has not been recorded from any of the Tertiary formations older than the Pliocene. Mr. Millett has found it in the St. Erth beds; and we have it from the Casterlian of the Kattendyke Docks, Antwerp. Mr. Millett has it from the Post-glacial beds of March, Cambridgeshire, and from the 'Challenger' dredgings of Station 185, Raine Island, at 155 fathoms. The figured specimen is from the Coralline Crag at Gomer; we have specimens from Gedgrave, zone f.



10. POLYMORPHINA COMMUNIS, *d'Orbigny*, 1826. Plate V, fig. 24; Plate VI, figs. 16 *a*, *b*.

- POLYMORPHINA (GUTTULINA) COMMUNIS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 266, No. 15, pl. xii, figs. 1—4; Modèle, No. 62.
- — — *Roemer*, 1838. Neues Jahrb., &c., 1838, p. 385, pl. iii, fig. 29.
- OBLONGA, *Roemer*, 1838. Ibid., p. 386, pl. iii, fig. 34.
- GUTTULINA VITREA, *d'Orb.*, 1839. Foram. Cuba, p. 133, pl. ii, figs. 1—3.
- POLYMORPHINA GLOMERATA, *Reuss*, 1845. Verst. böhm. Kreid., p. 40, pl. xii, fig. 32.
- GUTTULINA COMMUNIS, *Reuss*, 1846. In Geinitz's Grundriss Verstein., p. 668, pl. xxv, fig. 8.
- — — *d'Orb.*, 1846. For. Foss. Vien., p. 224, pl. xiii, figs. 6—8.
- GLOBULINA IRREGULARIS, *Idem*, 1846. Ibid., p. 226, pl. xiii, figs. 9, 10.
- DISCRETA, *Reuss*, 1850. Denks. k. Akad. Wiss. Wien, vol. i, p. 378, pl. xlviii, fig. 10.
- GUTTULINA CRETACEA, *Alth*, 1850. Haidingers Naturwiss. Abhandl., vol. iii, p. 262, pl. xiii, fig. 14.
- GLOBULINA CRETACEA, *Reuss*, 1851. Ibid., vol. iv, p. 44, pl. iv, fig. 10.
- GUTTULINA SEMIPLANA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Gesell., vol. iii, p. 82, pl. vi, fig. 48.
- ROBUSTA, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 246, pl. vi, fig. 65.
- POLYMORPHINA (GUTTULINA) COMMUNIS, *Egger*, 1857. Neues Jahrb., &c., p. 289, pl. ix, figs. 16—18.
- LATA, *Idem*, 1857. Ibid., p. 288, pl. ix, figs. 22—24.
- GLOBULINA TUBULIFERA, *Bornemann*, 1860. Zeitsch. Deutsch. Geol. Gesell., vol. xii, p. 160, pl. vi, fig. 10.
- BULLOIDES, *Reuss*, 1861. Sitz. k. Akad. Wiss. Wien., vol. xlv, Abth. 1, p. 318, pl. iii, fig. 4.
- POLYMORPHINA PROBLEMA, var. DELTOIDEA, *Reuss*, 1865. Denks. k. Ak. Wiss. Wien, vol. xxv, p. 154, pl. iv, fig. 8.
- COMMUNIS, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 29, pl. ii, fig. 47 (referred to *P. lactea*).
- GUTTULINA FISSURATA, *Stache*, 1865. Novara-Reise, Geol. Theil, vol. i, p. 263, pl. xxiv, fig. 10.
- OBLIQUATA, *Idem*, 1865. Ibid., vol. i, p. 264, pl. xxiv, fig. 11.
- No. 435, *Schlicht*, 1870. Foram. Pietzpuhl, p. 76, pl. xxvii, figs. 22—25 [= *Polymorphina semiplana*, *Reuss*, 1870, Sitzb. Akad., vol. xlii, p. 34].

- GUTTULINA, No. 447, *Schlicht*, 1870. Foram. Pietzpuhl, p. 78, pl. xxx, figs. 13—16.  
[= *P. problema*, var. *communis*, Reuss, Sitz. Akad., 1870, p. 33.]
- POLYMORPHINA, No. 493, *Schlicht*, 1870. Ibid., p. 84, pl. xxxii, figs. 17—20.  
[= *P. problema*, var. *deltoidea*, Reuss, Sitz. Akad., 1870, p. 33.]
- COMMUNIS, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 224, pl. xxxix, fig. 10.
- LONGICOLLIS, *Karrer*, 1870. Jahrb. k. k. geol. Reichsanstalt, vol. xx, p. 181, pl. xi, fig. 11.
- GRAVIS, *Karrer*, 1870. Ibid., p. 181, pl. xi, fig. 12.
- COMMUNIS, *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 306.
- — *B. and R.*, 1875. Rep. Brit. Assoc. for 1874, p. 190.
- PROBLEMA, var. DELTOIDEA, *Hantken*, 1875. Mitth. Jahrb. k. Ungar. geol. Anstalt, vol. iv, p. 59, pl. viii, fig. 3.
- GUTTULINA COMMUNIS, *Terquem*, 1875. Plage Dunkerque, p. 37, pl. v, fig. 14.
- — *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 45, pl. iv (ix), fig. 15.
- CENTRATA, *Terquem*, 1878. Ibid., p. 46, pl. ix, fig. 25.
- GRAVIDA, *Terquem*, 1878. Ibid., p. 47, pl. ix, figs. 28, 29.
- GLOBULINA IRREGULARIS, *Terquem*, 1878. Ibid., p. 44, pl. ix, figs. 13, 14.
- POLYMORPHINA COMMUNIS, *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 54.
- GUTTULINA PONDEROSA, *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, No. 3, p. 135, pl. xiv (xxii), fig. 1.
- COMMUNIS, *Terquem*, 1882. Ibid., p. 134, pl. xiii (xxi), figs. 40—42.
- POLYMORPHINA COMMUNIS, *Brady*, 1884. 'Chall.' Rep., p. 568, pl. lxxii, fig. 19.
- (GUTTULINA) PROBLEMA, var. DELTOIDEA, *Andreae*, 1884. Abhandl. geol. Special-Karte Elsass-Loth., vol. ii, pp. 210, 233, pl. ix, fig. 21.
- — COMMUNIS, *Basset*, 1885. Ann. Soc. Sci. Nat. Char.-Inf., No. 21, p. 161, fig. 62.
- GLOMERATA, *Beissel* (after *Roemer and Reuss*), 1891. Abhandl. K. Preuss. Landesanst., n. s., pt. 3, p. 62, pl. xii, figs. 17—20 (and variety, figs. 21—29).
- GIBBA, "near COMMUNIS," *Goës*, 1894. K. Svenska Vet.-Ak. Handl., vol. xxv, No. 9, p. 55, pl. ix, figs. 523, 524.
- COMMUNIS, *Chapman*, 1896. Journ. Roy. Micr. Soc., p. 13, pl. ii fig. 15.

*Characters*.—Shell ovate, acuminate anteriorly and rounded behind; somewhat compressed, with one face more convex than the other; four unequal chambers, rather gibbose, one overlapping another obliquely.

*Occurrence.*—*Polymorphina communis* (including *P. problema*) is essentially a shallow-water form, the greatest depth at which it has been observed being 155 fathoms (Brady). Its geographical range is almost world-wide.

As a fossil it has been found in the Lower Lias; the Neocomian (Bargate beds of Surrey); the Gault of Folkestone; the Red Chalk; the Oligocene of Elsass and Pietzpuhl, the Miocene of Vienna and Muddy Creek (Victoria); the Pliocene of Antwerp, Garrucha (Spain), and St. Erth. In the Coralline Crag we have specimens from every zone examined.

11. POLYMORPHINA PROBLEMA, *d'Orbigny*, 1826. Plate I, fig. 64; Plate V, fig. 23;  
Plate VI, figs. 12 *a*, *b*.

Part I, 1866, Appendices I and II, Tables, No. 51.

- POLYMORPHINA (GUTTULINA) PROBLEMA, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vi,  
p. 266, No. 14; Modèle No. 61.
- CRASSATINA, *Römer*, 1838. Neues Jahrb., &c., 1838, p. 385, pl. iii,  
fig. 30.
- SPICÆFORMIS, *Römer*, 1838. Ibid., p. 386, pl. iii, fig. 31.
- GUTTULINA PROBLEMA, *Reuss*, 1846. In Geinitz's Grundriss, &c., p. 669, pl. xxiv,  
fig. 83.
- — *d'Orb.*, 1846. For. foss. Vien., p. 224, pl. xii, figs. 26—28.
- AUSTRIACA, *d'Orb.*, 1846. Ibid., p. 223, pl. xii, figs. 23—25.
- POLYMORPHINA PROBLEMA, *Egger*, 1857. Neues Jahrb., &c., 1857, p. 287, pl. x,  
figs. 23—25.
- UVULA, *Egger*, 1857. Ibid., p. 285, pl. x, figs. 26—29.
- GUTTULINA ROTUNDATA, *Reuss*, 1864. Sitz. k. Ak. Wiss. Wien, vol. l, p. 469,  
pl. iii, fig. 4.
- INSIGNIS, *Reuss*, 1864. Ibid., p. 470, pl. iv, fig. 4.
- PROBLEMA, *Reuss*, 1864. Ibid., p. 470, pl. v, fig. 5.
- POLYMORPHINA SEPTATA, *Terquem*, 1864. 4e Mém. Foram. Lias, p. 301, pl. xiii,  
fig. 40.
- GUTTULINA PUSILLA, *Stache*, 1865. Novara-Reise, Geol. Th., vol. i, p. 264, pl. xxiv,  
fig. 12.
- POLYMORPHINA PROBLEMA, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3,  
vol. xvi, p. 28, pl. ii, fig. 50.
- — *J., P., and B.*, 1866. Monogr. Foram. Crag, Append.  
i and ii, pl. i, fig. 64.
- — *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii,  
p. 225, pl. xxxix, fig. 11.
- GUTTULINA INTRICATA, *Terquem*, 1874. Foram. Syst. Oolithique, p. 311, pl. xxxiii,  
fig. 30.
- POLYMORPHINA ACUTA, *Hantken*, 1875. Mitth. Jahrb. k. Ungar. geol. Anstalt,  
vol. iv, p. 60, pl. viii, fig. 4.



- POLYMORPHINA PROBLEMA, *Blake*, 1876. Yorkshire Lias, p. 470, pl. xvii, fig. 33.  
 — DISTINCTA, *Blake*, 1876. Ibid., p. 471, pl. xvii, fig. 35.  
 GUTTULINA AUSTRIACA, *Terquem*, 1876. Dunkerque, p. 78, pl. x, figs. 13—17.  
 — PROBLEMA, *Terquem*, 1876. Ibid., p. 79, pl. x, fig. 18.  
 — RACEMOSA, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3,  
 p. 46, pl. iv (ix), figs. 20—23.  
 — BULLOIDES, *Terquem*, 1878. Ibid., p. 47, pl. iv (ix), fig. 27.  
 — AUSTRIACA, var. ANGUSTA, *Terquem*, 1881. Plage Dunkerque, p. 130,  
 pl. xvii, fig. 5.  
 — — — OVALIS, *Terquem*, 1881. Ibid., p. 131, pl. xvii, fig. 6.  
 — — — *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii,  
 p. 133, pl. xxi, fig. 36.  
 — MUCRONATA, *Terquem*, 1882. Ibid., figs. 38, 39.  
 — PROBLEMA, *Terquem*, 1882. Ibid., p. 134, pl. xxi, figs. 43, 44.  
 POLYMORPHINA PROBLEMA, *Brady*, 1884. 'Challenger' Rept., p. 568, pl. lxxii,  
 fig. 20; pl. lxxiii, fig. 1.  
 — (GUTTULINA) PROBLEMA, *Basset*, 1885. Ann. Soc. Sci. N. Char.-  
 Inf., No. 21, p. 161, fig. 61.  
 BULIMINA PYRULA (part), *A. Silvestri*, 1893. Atti Rend. Acc. Scienze, vol. v,  
 p. 10, pl. v, figs. 79, 80.  
 POLYMORPHINA PROBLEMA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv,  
 No. 9, p. 56.

*Characters*.—Shell oblong-ovate, irregular. Chambers numerous, much inflated, and separated by deep sutures; sometimes arranged triserially, but more frequently crowded together irregularly.

D'Orbigny's *Modèle* No. 61 forms a convenient subtype, embracing a large group of *Polymorphinæ*, which have in common a somewhat acervuline mode of growth, and but little adhesion or overlap amongst the segments. His later figures of the same species are by no means so characteristic, and are scarcely separable from *P. communis*; of which, indeed, we consider *P. problema* to be a wild-growing modification.

*Occurrence*.—For the occurrence of this *Polymorphina*, which is intimately allied to *P. communis*, see the notes on the latter at page 267.

## 12. POLYMORPHINA TURGIDA, *Reuss*, 1855. Plate V, fig. 25.

- GUTTULINA TURGIDA, *Reuss*, 1855. Sitzungsber. k. Akad. Wiss. Wien, vol. xviii,  
 p. 246, pl. vi, fig. 66.  
 POLYMORPHINA (GUTTULINA) TURGIDA, *Reuss*, 1866. Denkschr. k. Akad. Wiss.  
 Wien, vol. xxv, p. 153,  
 No. 11.  
 GUTTULINA, No. 438 and No. 441, *Schlicht*, 1870. Pietzpuhl, p. 77, pl. xxviii, figs. 6  
 —10; and pl. xxix, figs. 1—5.

POLYMORPHINA TURGIDA, *Reuss*, 1870. Sitzungsab. k. Akad. Wiss. Wien, vol. lxii, I Abtheil., p. 487, No. 10. (After Schlicht's figures.)

*Characters*.—Shell subrotund, rounded-oblong in outline, being nearly equally rounded at the ends, with almost straight parallel sides. Both in vertical and transverse section it is compressed and bluntly oval (shortest in the latter); chambers four (?), oblique, gibbose, and closely set with indistinct septal lines.

Reuss's fig. 66 in pl. vi (1855), closely resembles this compact *Polymorphina*, except in being more oval. Fig. 9 in Schlicht's pl. xxviii, and fig. 2 in pl. xxix, are more circular in transverse section, but otherwise express the subrotund form of our specimen. Taken altogether, the *Polymorphina* under notice is certainly within the probable range of variation of *P. turgida*, Reuss.

*P. (globulina) globosa*, von Münster, described and figured by F. A. Römer in the 'Neues Jahrbuch,' &c., 1838, p. 386, pl. iii, fig. 33, evidently belongs to the same group as the above. It is "nearly round, smooth, with scarcely distinguishable chambers," and is slightly compressed.

*P. rotundata*, Bornemann (1855, 'Zeitsch. Deutsch. Geol. Ges.,' vol. vii, p. 346, pl. xviii, fig. 3, copied in the 'Trans. Linn. Soc.,' vol. xxvii, p. 234, woodcuts, figs. *k*, *l*, *m*), is a long-oval form, closely allied to the foregoing.

An obovate variety is recognised in the 'Challenger' Report, p. 570, pl. lxxiii, figs. 5—8. Other varieties are shown by Dr. A. Goës, 'K. Svensk. Akad. Handl.,' vol. xxv, No. 9, p. 57, pl. ix, figs. 529—534.

*Polymorphina solidula*, Terquem, 'Mém. Soc. Géol. France,' ser. 3, vol. i, Mém. 3, 1878, p. 40, pl. iii (viii), figs. 31 *a*, *b*, is another member of the same group of compact, subrotund, compressed forms.

*Occurrence*.—*P. turgida* comes from the Oligocene Septaria-clays of Germany, and *P. globosa* also from the younger Tertiaries of Northern Germany. The figured specimen (Pl. V, fig. 25), from the Crag of Sutton, is in the British Museum.

*P. rotundata*, mentioned above as a closely allied form, is not common in the recent condition. It has been found, according to the 'Challenger' Report, off the western coast of Scotland, and off the north-east of Ireland; in the Mediterranean off Malta; off Prince-Edward Island, Southern Ocean (50 to 150 fathoms); at one station in the North Pacific (1850 fathoms); and in the South Pacific (1825 fathoms). Dr. Goës has it among the Arctic Foraminifera.

Fossil specimens have been recorded from the Oligocene (Septaria-clays) of Hermsdorf and Pietzpuhl, and from the Miocene of Kostej in the Banat, Hungary.

13. POLYMORPHINA COMPLANATA, *d'Orbigny*, 1846. Plate I, figs. 52, 53, 60.

Part I, 1866, Appendix I, Table, No. 52; Appendix II, Table, No. 53.

- POLYMORPHINA CAMPANULATA, *Römer*, 1838. Neues Jahrb., &c., p. 385, pl. iii, fig. 22.
- OBSCURA, *Römer*, 1838. Ibid., fig. 23.
- TERETIUSCULA, *Römer*, 1838. Ibid., fig. 24.
- LINGUA, *Römer*, 1838. Ibid., fig. 25.
- COMPLANATA, *d'Orb.*, 1846. For. foss. Vien., p. 234, pl. xiii, figs. 25—30.
- PHILIPPIN, *Reuss*, 1855. Sitz. k. Akad. Wiss. Wien, vol. xviii, p. 248, pl. vii, fig. 76.
- LINGUA, *Reuss*, 1855. Ibid., fig. 77.
- COMPLANATA, *Mackie*, 1859. Rec. Sci., i, p. 148, fig. 24.
- — *Reuss and Fritsch*, 1861. Model No. 67, Catal. 1861; No. 72, Catal. 1865.
- SUBRHOMBICA, *Reuss*, 1861. Sitz. k. Acad. Wiss. Wien, vol. xlv, p. 339, pl. vii, fig. 3.
- OBSCURA, *Reuss*, 1864. Ibid., vol. 1, p. 471, pl. iii, figs. 8—10.
- COMPLANATA, *Jones, Parker, and Brady*, 1866. Monog. Foram. Crag, pl. i, figs. 52, 53, 60.
- — *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc., vol. xxvii, p. 230, pl. xl, figs. 14 *a*, *b*, and woodcuts *f* to *j*.
- FISCHERI (?), *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. i, No. 3, p. 41, pl. 3 (viii), figs. 38 *a*—*c*.
- SPATULATA, *Terquem*, 1882. Ibid., vol. ii, No. 3, p. 142, pl. xiv, (xxii), fig. 32.
- COMPLANATA, *Balkwill and Millett*, 1884. Journ. Microscopy, vol. iii, p. 84, pl. iv, fig. 9.
- — *Gümbel*, 1885. Geol. Bayern., 1 Theil, 2 Lief., p. 421, fig. 266<sub>15</sub>.
- — *Beissel*, 1891. Abhandl. K. Preuss. geol. Landes., n. s., pt. 3, p. 58, pl. x, figs. 48—53.

*Characters*.—Shell much compressed, elongate, or subrhomboidal. Chambers elongate, oblique, arranged in two regularly alternating series. Septal lines slightly excavated.

*Note*.—The name "*complanata*" given by *d'Orbigny*, though later than some others, has been adopted because of the good figure of the type.

*Occurrence*.—*Polymorphina complanata* is rare in the recent condition (coast of Galway). As a fossil it has been recorded from the Chalk of Maestricht;



from the Miocene of Vienna; and from the Upper Tertiaries of north-west Germany. We have specimens from the Casterlian of Antwerp; and Mr. Millett has recorded it from the Pliocene of St. Erth. In the Coralline Crag we have found it in every zone examined.

14. POLYMORPHINA FRONDIFORMIS, *Searles Wood*, 1843. Plate I, figs. 62, 63, 69 (var.); Plate IV, figs. 11—14; Plate VII, fig. 20 (var.).

Part I, 1866, Appendices I and II, footnotes.

POLYMORPHINA FRONDIFORMIS, *Searles Wood*, 1843. In *Morris's Catalogue of British Fossils*, p. 62.

— — — *Jones, Parker, and Brady*, 1866. *Monogr. Foram. Crag*, Appendices i and ii (footnotes), pl. i, figs. 62, 63 (not 69); pl. iv, figs. 11—14.

— — — *Brady, Parker, and Jones*, 1870. *Trans. Linn. Soc.*, vol. xxvii, p. 241, pl. xli, figs. 33 a—c.

*Characters*.—Shell large, elongate, compressed or complanate, unsymmetrical. Chambers long, oblique, irregular. Surface depressed over portions of the septal lines; sometimes smooth, but more frequently marked by exogenous shell-growths, either in the form of rounded beads or short, interrupted costæ.

This form is related to *P. complanata* (megalospheric?), but peculiar in its habit and locality. The ornamentation is very peculiar, and does not exactly correspond with what is seen in allied genera. It consists (as in *P. myristiformis*) of clear, bright, circular or oval beads, or of more or less interrupted costulæ of the same sort, distributed irregularly in longitudinal direction over the flat sides of the shell.

#### 14\*. Var. BREVIS.

Pl. VII, fig. 20, illustrates a varietal form, var. *brevis*, subovate in outline, with relatively shorter and fuller chambers, ornamented chiefly near the edge with irregular and subquadrate drop-like beads, such as occur among the costulæ on other specimens.

## 14\*\*. Var. LINEATA.

Pl. I, fig. 69, may be the young form of *P. frondiformis*, but is probably a small variety (var. *lineata*), more regularly ovate in outline, with its edges entire, its chambers fuller, and its surface ornamented with delicate longitudinal sculpturing, somewhat like that of *P. puchella*, d'Orb., and still more like that of the "striato-fistulose specimen from the Crag ('Trans. Linn. Soc.,' vol. xxvii, pp. 246 and 252). This specimen seems to have been lost; and unfortunately the figure escaped notice when the new plates and woodcuts were being drawn.

*Occurrence*.—As far as is at present known, *Polymorphina frondiformis* is absolutely peculiar to the Coralline Crag of East Anglia. At the time of the publication of the First Part of this Monograph, it had been found at Sutton only. We have now obtained specimens, with varying frequency, from every zone examined.

15. POLYMORPHINA VARIATA, Jones, Parker, and Brady, 1866. Plate I, figs. 67, 68; Plate V, fig. 27.

Part I, 1866, Appendices Nos. 1 and 2, Tables, footnotes.

POLYMORPHINA VARIATA, J., P., and B. Monogr. Foram. Crag, Appendices i and ii, footnotes; pl. i, figs. 67, 68; pl. v, fig. 27.

— — B., P., and J., 1870. Trans. Linn. Soc., vol. xxvii, p. 237, pl. xl, fig. 24.

*Characters*.—Shell suboblong, compressed, asymmetrical, few-chambered. Margin rounded, somewhat constricted at the septal lines. Chambers slightly inflated. Surface uneven, studded with irregular angular depressions imparting a mottled appearance to the whole exterior. Orifice variable; simple or labyrinthic.

These large *Polymorphinæ* from the Crag have a surface-ornamentation that has not been observed in specimens from other localities. It consists of unequal, irregular, angular depressions, sometimes bordered by a slightly raised line. The shell-wall is coarse and thick; and the terminal orifice sometimes differs from the normal circular aperture, becoming labyrinthic, or even divided into two or three distinct perforations.

*Occurrence*.—*Polymorphina variata*, like *P. frondiformis*, appears to be confined to the Coralline Crag of East Anglia. It has been found in every zone we have examined; but most plentifully at Sutton (zone f), and Sudbourne Hall (zone d).

16. POLYMORPHINA TUBERCULATA, *d'Orbigny*, 1846. Plate V, fig. 29.

GLOBULINA TUBERCULATA, *d'Orb.*, 1846. Foram. Foss. Vien., p. 230, pl. xiii,  
figs. 21, 22.

POLYMORPHINA (GLOBULINA) TUBERCULATA, *Egger*, 1857. Neues Jahrb. &c.,  
Jahrg., 1857, p. 292, pl. xiv, figs.  
7, 8.

GLOBULINA TUBERCULATA, *Reuss*, 1862. Sitz. k. Akad. Wiss. Wien, vol. xlvi,  
p. 79.

POLYMORPHINA TUBERCULATA, *Karrer*, 1868. Ibid., vol. lviii, p. 173.

— — — *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc.  
vol. xxvii, p. 242, pl. xli, figs.  
35 *a—d*.

*Characters*.—Shell subovate; extremities sometimes subacute; surface beset with tubercles, unequal and irregular; septa obscure.

*Occurrence*.—*Polymorphina tuberculata* has apparently not been recorded in a recent condition. Fossil specimens have been found in the Gault of North Germany; in the Miocene of Vienna (*d'Orbigny*), Lower Bavaria (*Egger*), and Kostež in the Banat (*Karrer*); also in the Casterlian of Antwerp.

The figured specimen is from the Coralline Crag, probably of Sutton.

17. POLYMORPHINA HIRSUTA, *Brady, Parker, and Jones*, 1870. Plate VI, figs. 14 *a, b*.

Part I, 1866 ("*P. rugosa*"), Appendix I, Table, No. 56; App. II, Table, No. 52.

POLYMORPHINA HIRSUTA, *Brady, Parker, and Jones*, 1870. Trans. Linn. Soc.,  
vol. xxvii, p. 243, pl. xlii, fig. 37.

— — — *Reuss*, 1870. Sitz. k. Akad. Wiss. Wien, vol. lxii,  
p. 486, No. 8; after *Schlicht's* No.  
510 (a fistulose specimen, p. 88),  
pl. xxxiv, figs. 1—3.

*Characters*.—Shell gibbous, subspherical, or ovate. Septa obscure. Surface beset with short bristles. This acerose ornament is common among some of the *Nodosarinæ*, but rare in their allies the *Polymorphinæ*.

*Occurrence*.—The only recent occurrence of this species is apparently that mentioned in the "Monograph on the genus *Polymorphina*," by *Brady, Parker, and Jones*, namely from the West Indies.

Fossil specimens seem to be rare. The records are from the Oligocene of



Pietzpuhl; the Pliocene of St. Erth, and the Coralline Crag. We have specimens from Sudbourne Hall, zone **d**; Broom Hill, zones **d** and **e**; Sutton, zones **e** and **f**; and Gedgrave, zone **f**.

17\*. Note on *POLYMORPHINA RUGOSA* (Part I, Appendices I and II, see above).

It is quite possible that *P. rugosa* had been noticed in the collections from the Crag, but lost sight of; and that the *P. hirsuta* subsequently observed may be quite distinct from the formerly recorded specimen of *P. rugosa*. A figure of the latter is therefore given here, since it may have occurred, and may be found again in the Crag.



FIG. 23.—*Polymorphina rugosa*, d'Orbigny. In the 'Trans. Linn. Soc.,' vol. xxvii, pl. xl, fig. 23a.   
× 12 diam.

In the 'Trans. Linn. Soc.,' vol. xxvii, 1870, p. 237, it is described as having its surface variously pitted and granular; and it is said to have been met with in shore-sand from Cuba and Martinique, and in some Tertiary deposits.

Genus 2.—*DIMORPHINA*, d'Orbigny, 1826.

*Brady, Challenger Report*, 1884, p. 70.

*ORTHOCERAS*, *Soldani*.

*DIMORPHINA*, d'Orbigny, *Sander Rang*, *Menke*, *von Reuss*, *Parker*, *Jones*, *Brady*, *Schwager*, *Karrer*, *von Schlicht*, *Buvignier*, *von Hantken*, *Costa*, *Alth*, *Brown*, *Ehrenberg*, *Basset*, *von Zittel*, and others.

*General Characters*.—Early chambers obscurely triserial (*Polymorphine*); later chambers uniserial (*Nodosarian*). Orifice at the summit of the terminal chamber.

1. *DIMORPHINA TUBEROSA*, d'Orbigny, 1826. Plate I, fig. 61; Plate VII, fig. 21.

Part I, Appendices Nos. I and II, Tables, No. 57 ("*D. nodosaria*," part).

*Orthoceras tuberosum*, *Soldani*, 1791. *Testaceograph.*, &c., vol. i, pt. 2, p. 99, pl. cvi, fig. gg.

- DIMORPHINA TUBEROSA, *d'Orb.*, 1826. *Ann. Sci. Nat.*, vol. vii, p. 264, No. 1 ;  
Modèle, No. 60.
- NODOSARIA, *d'Orb.*, 1846. *Foram. Foss. Vien*, p. 221, pl. xii, figs.  
21, 22.
- GLANDULINA DEFORMIS, *Costa*, 1856. *Atti Accad. Pontan.*, vol. vii, fasc. 2, p. 129,  
pl. xi, figs. 16—18, 26.
- DIMORPHINA TUBEROSA, *Parker, Jones, and Brady*, 1865. *Ann. Mag. Nat. Hist.*,  
ser. 3, vol. xvi, p. 28, pl. ii, fig. 53.
- NODOSARIA (part), *Jones, Parker, and Brady*, 1866. *Monogr. Foram.*  
*Crag*, Appendices, No. 57 (part), pl. i,  
fig. 61 (not fig. 66).
- TUBEROSA, *Brady, Parker, and Jones*, 1870. *Trans. Linn. Soc.*,  
vol. xxvii, p. 249, pl. xlii, figs. 39 *a, b*.
- — *Basset*, 1885. *Ann. Soc. Sci. Char.-Inf.*, p. 161, fig. 60.
- — *Fornasini*, 1886. *Boll. Soc. Geol. Ital.*, vol. v, p. 204,  
No. 231.
- DEFORMIS, *Fornasini*, 1890. *Mem. Accad. Sci. Bologna*, ser. 4, vol. x,  
p. 471, pl. o, figs. 35—37.
- TUBEROSA, *Fornasini*, 1891. *Foram. Plioc. Pontic. Sav. Bologna*,  
pl. ii, fig. 25.
- — *De Amicis*, 1895. *Naturalista Siciliano*, Ann. xiv, pp. 46  
and 63.
- DEFORMIS, *De Amicis*, 1895. *Ibid.*, pp. 47 and 63.

*Characters*.—Shell elongate, subcylindrical, straight, or nearly so. Anterior portion acuminate; posterior obtuse, and rounded. Early (alternating) chambers varying greatly in their proportion to the whole shell. Later (uniserial) chambers two to six in number, more or less inflated.

As explained in the "Monograph of the Genus *Polymorphina*," 1870, p. 249, there is no essential difference between d'Orbigny's *Dimorphina tuberosa* and his symmetrical *D. nodosaria*. So also *D. deformis* (Costa) appears to differ only in degree, by irregularity of growth, from *D. tuberosa*; and our fig. 21 of Pl. VII is within the varietal limits of the same species, though more even and fusiform in shape.

Taking the subcylindrical *Polymorphine* of the Crag as a group, we see that Pl. I, figs. 55—58 represent a type; Pl. I, fig. 61, is a tuberoso subtype; Pl. VII, fig. 21, is less tuberoso and more fusiform; whilst Pl. VII, fig. 17, is compressed and almost Marginuline in growth, with an eccentric beginning and uniserial upgrowth; and Pl. I, fig. 66, is still more compact and like a *Marginulina* in outline. The two latter forms are described under a separate trivial name.

A compressed form, very close to *D. tuberosa*, has been found in the Pliocene beds at St. Erth, by Mr. Millett.

*Occurrence*.—*Dimorphina tuberosa* is of rare occurrence both in the recent and fossil condition. Living specimens have been obtained from the Mediterranean at

depths not exceeding 100 fathoms. Fossil specimens have come from the Oligocene of Hermsdorf; Miocene of Vienna and Italy; and from the Pliocene of Garrucha, in Spain.

In addition to the figured specimen (Pl. I, fig. 61) from Sutton, we have found well-developed specimens from the same place in zone f.

2. DIMORPHINA COMPACTA, *Brady, Parker, and Jones*, 1870. Plate I, fig. 66 (" *D. tuberosa* "); Plate VII, fig. 17.

Part I, 1866, Appendices No. I and No. II, Tables, No. 58 (" *D. tuberosa* ").

DIMORPHINA TUBEROSA, *J., P., and B.*, 1866. Monogr. Foram. Crag, Appendices, No. 58, pl. i, fig. 66.

— COMPACTA, *B., P., and J.*, 1870. Trans. Linn. Soc., vol. xxvii, p. 250, pl. xlii, fig. 41.

*Characters.*—Shell elongate, subcylindrical, more or less arcuate, compactly built; anterior extremity obtuse or truncate; posterior rounded. Margin even; septa marked by faint lines.

Fig. 66, Pl. I, the specimen described in the "Monograph of Polymorphina," 1870, was separate from *D. tuberosa* on account of its marginuline form with compressed oblique uniserial chambers. Fig. 17, Pl. VII, also has a quasi-marginuline style of growth; and, although it is not so elongate and narrow as the other, its general outline and compact structure show its close alliance.

*D. compacta*, but having a slit-like aperture, has been met with by Mr. F. W. Millett at St. Erth. Moreover, a compressed Dimorphine *Polymorphina* has been found by Mr. Millett in these Pliocene beds, and described and figured by him in the 'Trans. Roy. Geol. Soc.,' Cornwall, vol. xi, part 9, 1895, p. 658, pl. o, figs. 5, 6 a, b, as *Polymorphina regularis*, var. *parallela*.

*Occurrence.*—*Dimorphina compacta* is not known in the recent condition. Excepting the above notice of its occurrence at St. Erth, the only record of its having been found is from the Coralline Crag of Sutton, whence both of our figured specimens were obtained.



*Genus 3*—UVIGERINA, *d'Orbigny*, 1826.

*Brady*, 'Challenger' Report, pages 682, 702.

UVIGERINA, *d'Orbigny*, *Sander Rang*, *Menke*, *Bronn*, *Czjzek*, *Reuss*, *Parker and Jones*, *Williamson*, *Morris and Quekett*, *Carpenter*, *Sequenza*, *Karrer*, *Brady*, *Stache*, *Schwager*, *Gümbel*, *Sars*, *Alcock*, *Parfitt*, *G. M. Dawson*, *Terquem*, *Terrigi*, *Sherborn*, *Chapman*, *Toutkowski*, *Goës*, *Ehrenberg*, *Fornasini*, *Woodward and Thomas*, *Marsson*, *von Hantken*, *Costa*, *Macdonald*, *Cuvier*, *Mackie*, *Zittel*, *Vine*, *Hoernes*, *Basset*, *Quenstedt*, *Egger*, *Mariani*, *Pictet*, *Suess*, *Millett*, and others.

*General Characters*.—Shell free, elongate, fusiform, obscurely spiral. Segments numerous; convex, or angular on their free surfaces. Aperture simple, central, in the tubular prolongation of the terminal chamber. See also *Carpenter's 'Introd. Study Foram.'*, 1862, p. 169.

1. UVIGERINA ANGULOSA, *Williamson*, 1858. Plate VII, fig. 26.

- UVIGERINA PYGMÆA, *Parker and Jones*, 1857. Ann. Mag. N. H., ser. 2, vol. xix, p. 297, pl. xi, figs. 41 and 43.
- ANGULOSA, *Williamson*, 1858. Rec. Foram. Gt. Brit., p. 67, pl. v, fig. 140.
- TRIGONA, *Sequenza*, 1862. Atti Accad. Gioenia, ser. 2, vol. xviii, pp. 110, 123, pl. ii, figs. 1, 1 a.
- PYGMÆA, var. ANGULOSA, *P. and J.*, 1865. Phil. Trans., vol. cli, p. 364, pl. xiii, fig. 58; pl. xvii, figs. 66 a, 66 b.
- CRISTATA, *Marsson*, 1878. Mitth. Nat. Ver. Neu-Vorpommern und Rügen, Jahrg. x, p. 150, pl. iii, figs. 20 a—d.
- ANGULOSA, *Sequenza*, 1880. Atti Accad. Linc., ser. 3, vol. vi, pp. 226 and 307.
- — *Bütschli*, 1880. Bronn's Klassen, &c., p. 200, pl. vii, fig. 31.
- — *Brady*, 1884. Report 'Challenger,' p. 576, pl. lxxiv, figs. 15—18.
- — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, Abth. ii, p. 314, pl. ix, figs. 40, 46, 47.

UVIGERINA ANGULOSA, *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 51, pl. ix, figs. 502—509.

— — — *De Amicis*, 1895. Nat. Sicil., vol. xiv, pp. 48 and 63.

*Characters*.—Shell subovate in outline, with sharp ends; triangular in cross-section. Chambers obscurely spiral and alternately angular, so that the shell has a nearly continuous ridge on each of its three faces. Surface of shell sometimes bearing irregular, longitudinal costulæ or wrinkles.

Of the drawings given by Dr. Brady, his fig. 18 most nearly corresponds with our fig. 26.

*Occurrence*.—*Uvigerina angulosa* has been found in almost all seas at depths ranging from 2 to 1630 fathoms ('Challenger') and 2328 fathoms ('Gazelle').

Fossils specimens have been recorded from the Miocene of Malaga and Italy; the Pliocene of Italy, St. Erth, and Antwerp (Casterlian). In the Coralline Crag we have specimens from nearly every zone examined.

2. UVIGERINA CANARIENSIS, *d'Orb.*, 1839; var. FARINOSA, *von Hantken*, 1875.  
Plate VII, fig. 27.

Part I, 1866, Appendix II, Tables, No. 73.

Testæ pineiformes minusculæ, *Soldani*, 1798. Testaceographia, &c., vol. ii, p. 18, pl. iv, figs. G, H (E, F correspond to *U. Canariensis*).

UVIGERINA NODOSA, var.  $\beta$ , *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 269, No. 2.

— CANARIENSIS, *d'Orb.*, 1839. Foram. Canaries, p. 138, pl. i, figs. 25—27.

— IRREGULARIS, *Brady*, 1865. Nat. Hist. Trans. Northumberland and Durham, vol. i, p. 100, pl. xii, fig. 5.

— — — 1870. Ann. Mag. Nat. Hist., 4 ser., vol. vi, pp. 297, 306.

— FARINOSA, *Hantken* (1875), 1881. Mittheil. Jahrb. k. Ung. geol. Anstalt, vol. iv, p. 62, pl. vii, fig. 6.

— CANARIENSIS, *Brady*, 1884. Rep. 'Challenger,' p. 573, pl. lxxiv, figs. 1—3.

*Characters*.—Shell ovato-acuminate. Chambers irregular, subconvex. Surface smooth.

There are intermediate forms between *U. farinosa* and *U. Canariensis*; but the former is sufficiently distinct to be retained as a variety. It may be said to have

much the same relationship to *U. Canariensis* as *U. tenuistriata* has to *U. pygmæa*.

*Occurrence*.—The typical *Uvigerina Canariensis* has a wide geographical and bathymetrical range. The 'Challenger' records as to depth vary from shore-sands to 1900 fathoms; and the specimens were obtained from several widely separated stations in the North and South Atlantic, and in the South Pacific.

Egger, in his Memoir on the Foraminifera obtained by the 'Gazelle,' records specimens from off the coasts of Mauritius, Western Australia, and New Guinea.

We have specimens in our own collections from soundings obtained by H.M.S. 'Penguin' from two stations in the Indian Ocean, one of them due south of Ceylon, at depths of 1040 and 1277 fathoms respectively.

In the fossil condition specimens have been obtained from the Chalk of Taplow; the Miocene of Vienna and Muddy Creek (Victoria), and the Pliocene of Kar Nicobar. In the Coralline Crag we have specimens from Tattingstone, zone **d**; Sutton, zone **e**; and Gedgrave, zone **f**. In the First Part of this Monograph, *U. Canariensis* (" *U. irregularis* ") was recorded from the Red Crag (Appendix I, Table, No. 59; App. II, Table, No. 73); but the specimen has been lost. Var. *farinosa* (Hantken) is from the Tertiary of Hungary.

#### Family 4.—GLOBIGERINIDÆ.

*General Characters*.—Test free, calcareous, perforate; chambers few, inflated, arranged spirally; aperture simple or multiple, conspicuous. No supplementary skeleton nor canal-system. Some of the larger forms pelagic in habit.

#### Genus 1—GLOBIGERINA, d'Orbigny, 1826.

*Echinus*, Walker and Jacob.

*Polymorphum*, Sphærule, &c., Soldani.

GLOBIGERINA, d'Orbigny, Sander Rang, Menke, Bronn, Reuss, Brown, Ehrenberg, Bornemann, Parker and Jones, Egger, Williamson, Morris and Quekett, Carpenter, Seguenza, Karrer, Wallich, Brady, Costa, Gümbel, Alcock, Parfitt, G. Dawson, Römer, Bailey, Pourtales, S. Owen, Schwager, Hogg, Terquem, Wright, Stache, von Hantken, Terrigi, Cuvier, Pictet, Mackie, Suess, Kübler and Zwingli, Chapman, Thomson, Toulà, Vanden Broeck, Hertwig, Hopkins, Nicholson, Bütschli, Goës, Andreae, Basset, Woodward and Thomas, Quenstedt, Sherborn, Malagoli, A. Agassiz, Steinmann,



*Mariani, von Hagenow, Mantell, Beudant, Hitchcock, Cooke, Toutkowsky, Fritel, Prestwich, Erc, Brandt, Hoernes, Gosse, Balkwill, Millett, Berthelin, Miller, Fornasini, Dunikowski, Chimmo, Sorby, Huxley, Macdonald, Schlicht, Ansted, Neumayr, Moseley, Schacko, De Amicis, Dervieux, Deshayes, Silvestri, Ciofalo, Cafici, Neviani, Sacco, Corti, Schrodt, Guppy, and others.*

ALLOTHECA (?), ARISTEROSPIRA, HEMISTEREA (?), HEMISTICTA PHANEROSTOMUM, PLANULINA, POROSPIRA, PTYGOSTOMUM, PYLODEXIA, *Ehrenberg.*

RHYNCHOSPIRA (?), *Ehrenberg, Reuss (MS.), Karrer.*

ROSALINA, *d'Orbigny, Ehrenberg, Reuss, Jones.*

ROTALIA, *Ehrenberg, Kübler, and Zwingli.*

ROTALINA, *Seguenza.*

*General Characters.*—Shell free, coarsely perforate, planospiral, trochoid, rotaliform, or agglomerate; chambers few, inflated, arranged more or less on a spiral plan. Aperture large at the umbilical face of the chambers.

Probably no single type of recent Foraminifera has attracted as large an amount of attention as *Globigerina*, partly from its exceedingly wide distribution and its extraordinary abundance, but more from the interesting questions of life-history, and even of physical geography, which are associated with its occurrence.

The type appears to admit of some amount of variation in external characters, though these exist within narrower limits than is often the case; the differentiation from the central form being chiefly in respect to the greater or less regularity in mode of growth, the number and sphericity of the segments, and the varying condition of the surface and texture of the shell.

Whilst conscious that the whole of the modifications arising in these ways may be connected in unbroken series with the central form, and consequently that there is no ground for *specific* subdivision in any right sense, we are bound to admit the convenience of recognising the names applied by various authors to the more prominent and best-marked forms, and to accord to them a certain sub-specific or varietal value.

# 1. GLOBIGERINA BULLOIDES, *d'Orbigny*, 1826. Plate II, figs. 1, 2.

Part I, 1866, Appendix I, Table, No. 61; II, Table, No. 59.

Polymorpha, *Tuberosa* et *Globulifera*, *Soldani*, 1791. Testaceographiæ, &c., vol. i, pt. 2, p. 117, pl. cxxiii, figs. H, I, L, N, O, P; pl. cxxiv, all the figs. except Z; pl. cxxv; and half of the figs. in pl. xxxi.

- Sphærulæ*, Testæ tuberosæ ac globuliferæ, *Soldani*, 1798. Ibid., vol. ii, p. 20, pl. vi, figs. *dd*, *ee*.
- GLOBIGERINA BULLOIDES, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 277, No. 1; Modèles, No. 17 (young) and No. 76.
- — (*Giroidina* in the text), *Cuvier*, 1829-43. *Guérin-Meneville*, Iconographie, Mollusques, p. 9, pl. ii, fig. 12.
- — *Cuvier*, 1834-37. Henderson's Anim. Kingd., ed. 3, p. 18, pl. iii, fig. 12.
- — *Deshayes*, 1830. Vers. Encycl. Méth., vol. ii, p. 170.
- — *Roemer*, 1838. N. Jahrb., &c., p. 390, pl. iii, fig. 42 *a*.
- — *d'Orbigny*, 1839. Foram. Amér. Mérid., p. 37.
- — *d'Orbigny*, 1839. Foram. Canaries, p. 132, pl. ii, figs. 1-3, 28.
- HIRSUTA, *d'Orbigny*, 1839. Ibid., p. 133, pl. ii, figs. 4-6.
- SIPHONIFERA, *d'Orbigny*, 1840. Foram. Cuba (Spanish edit.), p. 95, pl. iv, figs. 15-18.
- BULLOIDES, *d'Orbigny*, 1846. For. Foss. Vien., p. 163, pl. ix, figs. 4-6.
- — *Pictet*, 1846. Traité Paléont., iv, p. 232, pl. xii, fig. 16; edit. 2, 1857, p. 509, pl. cix, fig. 29.
- CONCINNA, *Reuss*, 1849. Denkschr. k. Akad. Wiss. Wien, vol. i, p. 373, pl. xlvii, fig. 8.
- DIPLOSTOMA, *Reuss*, 1849. Ibid., p. 373, pl. xlvii, figs. 9, 10; pl. xlviii, fig. 1.
- BULLOIDES, *Bronn*, 1835-56. Leth. Geogn., ed. 3, iii, p. 228, pl. xxxv<sup>2</sup>, figs. 19 *a-c*.
- DEPRESSA, *Ehrenberg*, 1854. Mikrogeologie, pl. xix, fig. 92.
- FOVEOLATA (pars), *Ehrenberg*, 1854. Ibid., pl. xxii, fig. 74.
- CRETÆ, *Ehrenberg*, 1854. Ibid., pl. xxvi, fig. 44; pl. xxx, fig. 38.
- STELLATA, *Ehrenberg*, 1854. Ibid., pl. xxvi, fig. 45. •
- TERNATA, *Ehrenberg*, 1854. Ibid., pl. xxxv B, figs. 5, 6.
- PLANULINA POROTETRAS, *Ehrenberg*, 1854. Ibid., pl. xx, ii, fig. 16.
- PERTUSA, *Ehrenberg*, 1854. Ibid., pl. xxii, fig. 75.
- STIGMA, *Ehrenberg*, 1854. Ibid., pl. xxv, fig. 29.
- ROTALIA RUDIS, *Ehrenberg*, 1854. Ibid., pl. xxiv, figs. 35, 36.
- LEPTOSPIRA, *Ehrenberg*, 1854. Ibid., fig. 39.
- SENARIA (pars.), *Ehrenberg*, 1854. Ibid., fig. 40.
- PTYGOSTOMUM ORPHEI, *Ehrenberg*, 1854. Ibid., pl. xxxv B, figs. 1, 2.
- PHANEROSTOMUM ATLANTICUM, *Ehrenberg*, 1854. Ibid., figs. 3, 4.
- GLOBIGERINA BULLOIDES, *Costa*, 1856. Atti Accad. Pontan., vol. vii, part 2, p. 242, pl. xxi, figs. 1, 2.
- — *Egger*, 1857. N. Jahrb., &c., p. 282, pl. xi, figs. 14-16.
- — *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 291, pl. xi, figs. 11, 12.

## FORAMINIFERA OF THE CRAG.

- GLOBIGERINA BULLOIDES, *Williamson*,<sup>1</sup> 1858. Rec. Brit. For., p. 56, pl. v, figs. 116—118.
- — *Bronn*, 1859. Klassen, p. 70, pl. vi, figs. 9 a—c.
- — *Mackie*, 1859. Recreat. Sci., vol. i, p. 147, fig. 9.
- — *Suess*, 1862. Boden Stadt Wien, p. 45, fig. 1<sup>4</sup>.
- — *Silvestri*, 1862. Atti X Congresso, &c., p. 82.
- — *Seguenza*, 1862. Atti Acc. Gioenia Sci. nat., ser. 2, vol. xviii, p. 103.
- — *Stache*, 1864. Novara-Exped. Geol., part 1, p. 286, pl. xxiv, figs. 35 a—e.
- — *Reuss*, 1865. Model, No. 69 (No. 91, Catal., 1861).
- — *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 21, pl. ii, fig. 56; p. 31, pl. ii, fig. 55.
- — *J., P., and B.*, 1866. Monogr. Foram. Crag, App. I and II, No. 61 and No. 59, pl. ii, figs. 1, 2.
- — *Kübler and Zwingli*, 1866. Neujahrsblatt Bürgerbibl. Winterthur, pt. 2, p. 22, pl. iii, figs. 30, 31.
- TAMINENSIS, *Kubler and Zwingli*, 1866. Ibid., pp. 24, 28, pl. iii, figs. 26, 29.
- BULLOIDES, *P. R. I., Owen*, 1868. Journ. Linn. Soc. Zool., vol. ix, p. 148, pl. v, figs. 6—9, 11, 12.
- — *Mackie*, 1867. Science Gossip, p. 130, fig. 127.
- — *Gümbel*, 1868 (1870). Abh. k. Bayer. Akad. Wiss., vol. x, p. 661, pl. ii, figs. 106 a, b.
- ALPIGENA (?) *Gümbel*, 1868. Ibid., p. 661, pl. ii, fig. 107.
- EOCÆNA, *Gümbel*, 1868. Ibid., p. 662, pl. ii, fig. 109.
- — *Anon.*, 1870. Sci. Goss., p. 12, fig. 31.
- — *P., J., and B.*, 1871. Ann. Mag. N. H., ser. 4, vol. viii, p. 175, pl. xi, fig. 112.
- PLANULINA MAURYANA, *Ehrenberg*, 1873. Abhandl. k. Akad. Wiss., Berlin, p. 388, pl. iii, fig. 1.
- GLOBIGERINA, *Ehrenberg*, 1873. Ibid., fig. 3.
- MEGALOPENTAS, *Ehrenberg*, 1873. Ibid., pl. iv, fig. 7.
- PYLODEXIA PLATYTETRAS, *Ehrenberg*, 1873. Ibid., pl. iii, fig. 14.
- ARISTEROSPIRA OMPHALOTETRAS, *Ehrenberg*, 1873. Ibid., fig. 15.
- GLOBIGERINA BULLOIDES, *Thomson*, 1873. Depths Sea, p. 22, fig. 2.
- — *Brady and Robertson*, 1875. Rep. Brit. Assoc., p. 191.
- DETRITA, *Terquem*, 1875. Dunkerque, p. 31, pl. iv, figs. 4 a—c.
- BULLOIDES, *Terquem*, 1875. Ibid., figs. 5 and a, b.
- — *Toula*, 1875. Mitth. Geogr. Ges. Wien, vol. xviii, p. 165, pl. o, fig. 13.

<sup>1</sup> The description includes "arenaceous" texture, perhaps referring to *Haplophragmium globigeriniforme*.



- GLOBIGERINA BULLOIDES, *Thomson*, 1875. Proc. Roy. Soc., vol. xxiii, p. 34, fig. 1.
- — *Hantken*, 1875 (1881). Mitth. Jahrb. k. Ungar. Geol. Anstalt, vol. iv, p. 69, pl. viii, fig. 2.
- — *Brady*, 1875. Ann. Mag. N. H., ser. 4, vol. vi, p. 306.
- — *Morris*, 1876. Lecture Geol. Croydon, p. 8, figs. 2<sup>3</sup>, 3<sup>3</sup>.
- — *Wallich*,<sup>1</sup> 1876. Deep-sea Researches, Biol. Globig., pp. 1—78, figs. 1—9, 11, 12, 17, 18.
- — *Anon*, 1876. Amer. Journ. Microsc., vol. i, p. 125, fig. 1.
- — *Hertwig*, 1877. Jenaische Zeitsch. Naturw., vol. xi, p. 343, pl. xx, fig. 8.
- — *Thomson*, 1877. Voyage 'Challenger,' vol. i, p. 211, fig. 46.
- — *Hopkins*, 1878—9. Report Chief Engineers, series 2, App. W. (Congress, &c.), p. 885, pl. ii, fig. 70.
- — *Ciofalo*, 1878. Atti Acc. Gioenia Sci. Nat., ser. 3, vol. xii, p. 7.
- — *Brady*, 1879. Quart. Journ. Micr. Soc., n. s., vol. xix, p. 71.
- — *Nicholson*, 1879. Manual Palæont., vol. i, p. 99, fig. 13 *f*; p. 115, fig. 18 *k*.
- — *Bütschli*, 1880. Bronn's Klassen, p. 201, pl. viii, figs. 9 and 28.
- — *Terrigi*, 1880. Atti Accad. Pont. Nuovi Lincei, vol. xxxiii, p. 186, pl. i, fig. 17 (= ? *cretacea*).
- — *Carpenter*, 1881. The Microscope, ed. 6, p. 569, figs. 325—327.
- — *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 85, pl. ix (xvii), figs. 2 *a*, *b*.
- — *Goës*, 1882. K. Svensk. Vet.-Akad. Handl., vol. xix, No. 4, p. 90, pl. vi, figs. 195—207 (restricted in 1894 to fig. 203).
- — *Cafici*, 1883. R. Accad. Lincei, ser. 3, vol. xiv, p. 85.
- — *Jones*, 1883. Microgr. Dict., p. 358, pl. xxiv, figs. 2, 3.
- — *Schwager*, 1883. Palæontogr., vol. xxx, p. 118, pl. xxvii (iv), figs. 5 *a*—*c*.
- — *Terquem*, 1883. 5me Mém. Foram. Oolith., p. 365, pl. xli, figs. 10 *a*, *b*.
- — *Fornasini*, 1883. Boll. Soc. Geol. Ital., vol. ii, p. 180; vol. iv, 1885, p. 114; vol. v, 1886, pp. 210, 211, 231, 236.
- — *Andreae*, 1884. Abh. Geol. Sp.-Kart. Elsass-Loth., vol. ii, pt. 3, p. 218, pl. ix, fig. 1, 2.
- — *Brady*, 1884. Report 'Challenger,' p. 593, pl. lxxvii; and pl. lxxix, figs. 3—7.
- — *Basset*, 1885. Ann. Char.-Inf., p. 162, figs. 17 and 76.

<sup>1</sup> See also his 'North-Atlantic Sea-bed,' 1862, pl. vi.

## FORAMINIFERA OF THE CRAG.

- GLOBIGERINA BULLOIDES, *Woodward and Thomas*, 1885. Thirteenth Ann. Rep. Geol. N. H. Survey Minnesota, p. 172, pl. iii, fig. 13 [also 17 and 18].
- — *Gümbel*, 1885. Geol. Bayern, vol. i, pt. 2, p. 421, figs. 266<sup>20</sup>.
- — *Quenstedt*, 1885, edit. 3, pt. 5, p. 1057, pl. lxxxvi, fig. 49.
- — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 8 *a, b*.
- — *Hogg*, 1886. Microscope, edit. 11, pl. iii, figs. 79, 81.
- — ? *Terquem*, 1886. Mém. Soc. Géol. Fr., ser. 3, vol. iv, No. 2, p. 56, pl. vi (xii), fig. 24.
- OOLITHICA [?], *Terquem*, 1886. Ibid., p. 57, pl. vi (xii), figs. 25 *a, b*.
- BULLOIDES, *Malagoli*, 1887. Boll. Soc. Geol. Ital., vol. vi, p. 521, pl. xiii, fig. 7.
- — *Anon. [Chapman]*, 1888. Sci. News, p. 413, fig. 16.
- — *Agassiz*, 1888. Cruises 'Blake,' vol. ii, p. 167, fig. 511.
- — *Steinmann*, 1888. Elém. Paléont., vol. i, p. 28, fig. 10.
- — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 225, pl. xlv, fig. 15.
- — *Mariani*, 1889. Boll. Soc. Geol. Ital., vol. vii, p. 288, pl. x, figs. 14, 15.
- — *Häusler*, 1890. Abh. Schweiz. Pal. Ges., vol. xvii, p. 118, pl. xv, fig. 46.
- — *B., S., and B.*, 1890. Journ. R. Micr. Soc., p. 561, pl. xi, fig. 17.
- — *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 101, pl. iii, figs. 26, 27 ; pl. iv, fig. 1.
- — — 1891. Ibid., vol. iv, pt. 1, p. 101, pl. iv, fig. 26.
- — *Corti*, 1892. Rendic. R. Istit. Lombardo, ser. 2, vol. xxv, p. 13, pl. iv, fig. 10.
- — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, Abth. ii, p. 362, pl. xiii, figs. 1—4.
- — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 435.
- — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 83, pl. xiv, figs. 754—762.
- — *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 36, pl. iv, figs. 13 *a—d*.
- — *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 51 and 63.

*Characters.*—Shell spiral, consisting of about two convolutions, composed of highly globular segments, which increase very rapidly in size ; the outermost convolution usually containing four segments, visible on the inferior surface, the remainder visible only on the superior surface. Orifice very large on the lower umbilical margin of the much inflated ultimate segment. Frequently the individual chambers open directly into the deep central umbilicus of the inferior surface. Our figs. 1 and 2, in Pl. II, represent a small typical *Gl. bulloides*.

*Occurrence.*—*Globigerina bulloides* is a cosmopolitan species, found at all depths. Its earliest recorded appearance is in the Devonian (Terquem, 'Bull. Soc. Géol. France,' ser. 3, vol. viii, 1880, p. 418, pl. xi, figs. 10 *a—c*); it occurs in the Jurassic (Terquem and Häusler); it is abundant in the Chalk-marl and Chalk; and it has been found in nearly all subsequent marine deposits.

It forms an important constituent of the existing sea-bed wherever the depth of water exceeds 100 fathoms. At smaller depths it is comparatively rare; but it abounds on some coasts, and chance specimens have been found in brackish shallows, and even in the rivers of the Fen districts of Lincolnshire at a distance from the open sea.

*Globigerina bulloides* is one of the pelagic species collected by towing nets in the open ocean, in company with two or three species of *Pulvinulina*.

It seems that the Crag sea was not very favorable to the existence of this species; small specimens, however, are found throughout the Coralline Crag, and in the Upper Crag of Southwold.

## 2. GLOBIGERINA LINNÆANA (*d'Orbigny*), 1839. Plate VII, figs. 23 *a, b, c*.

ROSALINA LINNÆANA, *d'Orb.*, 1839. Foram. Cuba, p. 101, pl. v, figs. 10—12.

— CANALICULATA, *Reuss*, 1854. Denksch. k. Ak. Wiss. Wien, vol. vii, p. 70, pl. xxvi, figs. 4 *a, b*.

GLOBIGERINA LINNÆANA, *Brady*, 1884. Report 'Challenger,' p. 598, pl. lxxxii, figs. 12 *a, b*; pl. cxiv, figs. 21 *a—c*.

— — *Burrows, Sherborn, and Bailey*, 1890. Journ. R. Microsc. Soc., p. 561, pl. xi, fig. 19.

ROTAIA ASPERA, *Beissel* (after *Ehrenberg*<sup>1</sup>), 1891. Abhandl. K. Preus. Landes., n. s., pt. 3, p. 73, pl. xiv, figs. 1, 2.

*Characters.*—Rotaliform, compressed, slightly convex above, somewhat concave with a sunken umbilicus below; edge square and bicarinate, hence canaliculate; chambers numerous, strongly limbate; apertures opening in the umbilicus; surface rough.

*Occurrence.*—The only record of this species in the recent condition appears to be that of the original from the shore-sands of the Island of Cuba. It is a common Cretaceous fossil, but it does not appear to have been met with in later deposits until we found specimens in the Coralline Crag of Sudbourne and Broom Hill (both zone *d*).

<sup>1</sup> Beissel refers also to the 'Mikrogeologie,' pl. xxvii, figs. 57, 58, which occur among young and adult forms of *Gl. cretacea* (figs. 53—59, and perhaps 60—64) (see 'Ann. Mag. Nat. Hist.,' ser. 4, vol. ix, p. 294). These falsely appear to be marginate, owing to the translucent edges of the chambers (seen by transmitted light), as is the case with many figures in this and other plates.



*Genus 2.*—PULLENIA, *Parker and Jones*, 1862.

PULLENIA, *Parker and Jones, Schwager, Bütschli, Andreae, Steinmann, Seguenza, von Reuss, von Hantken, Brady, Carpenter, Terrigi, Balkwill, Wright, Hamilton, Goës, Sherborn, Chapman, Egger, von Zittel, and others.*

NONIONINA, *d'Orbigny, Czjzek, von Reuss.*

*General Characters.*—Regularly or obliquely nautiloid and involute; chambers slightly ventricose; perforations fine; aperture a long curved slit at the union of the last chamber with the previous convolution.

1. PULLENIA SPHÆROIDES (*d'Orbigny*), 1826. Plate II, figs. 31, 32.

Part I, 1866; Appendix I, Table, No. 62; Appendix II, Table, No. 60.

Orthocerata unilocularia vel multilocularia, &c., *Soldani*, 1780. Saggio Orittogr., p. 108, pl. vi, fig. s.

NONIONINA SPHÆROIDES, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 293, No. 1; Modèle, No. 43.

— BULLOIDES, *d'Orb.*, 1826. Ibid., No. 2.

— — — 1846. For. Foss. Vien., p. 107, pl. v, figs. 9, 10.

— QUATERNARIA, *Reuss*, 1850. Haiding. Nat. Abhandl., vol. iv, p. 34, pl. ii, fig. 13.

PULLENIA SPHÆROIDES, *Carpenter*, 1862. Introd. Foram., p. 184, pl. xii, fig. 12 ("bulloides" in explan. plate).

— — — *P. and J.*, 1865. Phil. Trans., vol. clv, p. 368, pl. xiv, figs. 43 a, b.

— — — *P., J., and B.*, 1866. Monogr. Foram. Crag, Appendices I and II, Nos. 60, 62, pl. ii, figs. 31, 32.

— — — *Reuss*, 1866. Denksch. k. Ak. Wiss. Wien, vol. xxv, p. 150.

NONIONINA, Nos. 339, 340, *Schlicht*, 1870. Foram. Pietzpuhl, p. 58, pl. xx, figs. 1—4 (= PULLENIA BULLOIDES, *Reuss*, 1870. Sitz. k. Ak. Wiss. Wien, vol. xlii, p. 484).

PULLENIA BULLOIDES, *Hantken*, 1875 (1881). Mitth. Jahrb. k. Ungar. Geol. Anstalt., p. 59, pl. x, fig. 9.

— — — *Zittel*, 1876. Handb. Pal., i, p. 88, fig. 25<sup>2</sup>.

— — — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 25, pl. o, fig. 14.

— — — *Bütschli*, 1880. Bronn's Klassen, &c., p. 211, pl. ix, fig. 14.

— SPHÆROIDES, *Terrigi*, 1880. Atti Acc. Pont. Lincei, vol. xxiii, p. 189, pl. i, fig. 21.

— — — *A. Hamilton*, 1881. Transact. New-Zealand Instit., p. 393, pl. xvi, fig. 15.

- PULLENIA SPHÆROIDES, *Goës*, 1882. K. Sv. Ak. Handl., vol. xix, No. 4, p. 104, pl. viii, figs. 248—250.
- — *Brady*, 1884. Report 'Challenger,' p. 615, pl. lxxxiv, figs. 12, 13; p. 616, cut, fig. 18.
- BULLOIDES, *Andreae*, 1884. Abh. Geol. Sp.-Kart. Elsass-Loth., vol. ii, pt. 3, p. 206, pl. ix, fig. 23.
- — *Balkwill and Wright*, 1885. Trans. R. Irish Acad. (Sci.) pp. 348 and 362, pl. xii, figs. 28 *a*, *b*.
- — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 10 *a*, *b*.
- — *Steinmann*, 1888. Elém. Paléont., vol. i, p. 32, fig. 16.
- SPHÆROIDES, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 226, pl. xliii, figs. 21 and 24.
- — *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 104, pl. iv, fig. 5.
- — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 372, pl. xix, figs. 30, 31.
- — *Goës*, 1894. K. Sv. Vet.-Ak. Handl., vol. xxv, No. 9, p. 87, pl. xiv, figs. 771, 772.
- — *Fornasini*, 1894. Foram. Coll. Soldani, Sagg. Oritt., p. 17.
- — *Egger*, 1895. Jahresb. xvi, Nat. Ver. Passau, p. 39, pl. iv, figs. 21 *a*, *b*.

*Characters*.—Shell small, subglobular, and like *Nonionina* in shape; chambers convex, four or five in each of the three or four whorls, each of which completely invests the previous whorl. The septal face arched, narrow, and bearing the long, transverse, crescentic, slit-like aperture in the under part of the chamber. Surface smooth, and suture slightly depressed. Figs. 31, 32, in Pl. II, are fairly typical.

*Occurrence*.—*Pullenia sphæroides* is a cosmopolitan species; most commonly met with at depths exceeding 300 fathoms. Specimens have been found as low down as 2750 fathoms. The list of localities at which this Foraminifer has been taken are thus given in the 'Challenger' report:—Davis' Strait, Novaya Zemlya, East Coast of Norway, Farøe Channel, British Seas, Mediterranean, Red Sea, North and South Atlantic, Southern Ocean, and the South and North Pacific.

An examination of material collected by H.M.S.S. 'Stork' and 'Penguin' enables us to add to the above list five stations in the Indian Ocean (1040—2694 fathoms).

The geological range of the species extends to the Cretaceous period. It has been found in the Chalk of Westphalia and Ireland, in the Eocene (London Clay), in the Oligocene of Elsass and Germany, in the Miocene of Vienna, Malaga, the Banat (Karrer), and Malta (Brady), and in the Pliocene of Italy and Garrucha.

In the Coralline Crag it has been found in nearly every zone examined. It has also been met with in the Red Crag of Essex, as noted in the First Part of this Monograph.

*Family 5.—ROTALIDÆ.*

*General Characters.*—Test calcareous, perforate; free or adherent. Typically spiral, and coiled in such a manner that all the chambers are visible on the upper surface, and only those of the last whorl on the inferior or apertural side; sometimes one face being more convex, sometimes the other. Aberrant forms evolute, outspread, acervuline, or irregular. Some of the more highly modified forms have double chamber-walls, supplemental skeleton, and a canal-system.

*Sub-family 1.—SPIRILLININÆ.*

*General Characters.*—Test free, spiral, discoidal, non-septate. Aperture simple, the open end of the tube.

*Genus 1.—SPIRILLINA, Ehrenberg, 1841.*

*Carpenter, 'Introd. Foram.,' 1862, p. 180.*

*SPIRILLINA, Ehrenberg, Parker and Jones, Williamson, Carpenter, von Gümbel, Brady, Kübler and Zwingli, Terquem, Siddall, Berthelin, Möbius, Häusler, Egger, Schacko, and others.*

*OPERCULINA, von Reuss.*

*CORNUSPIRA, Schultze.*

*CYCLOLINA, Egger.*

- 1\*. *SPIRILLINA VIVIPARA, Ehrenberg, 1843, var. MINIMA (Schacko). Plate VI, fig. 22*  
(*var. unilinearis, nov., in the explanation of that plate.*)

*Synonyms of the Type-form :*

- ? *SPIRILLINA VIVIPARA, Ehrenberg, 1843. Abhandl. k. Akad. Wiss. Berlin, vol. for*  
1841, p. 443, pl. iii, vii, fig. 41.  
— — [?] — 1847. *Ibid.*, vol. for 1846, p. 446, pl. ii, i,  
fig. 82.  
*OPERCULINA PUNCTATA, Reuss, 1849. Denkschr. k. Akad. Wiss. Wien, vol. i,*  
p. 370, pl. xlvi, fig. 21.



- CORNUSPIRA PERFORATA, *Schultze*, 1854. Organ. Polythal., p. 41, pl. ii, fig. 22.
- SPIRILLINA VIVIPARA, *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., ser. 2, vol. xix, p. 284, pl. xi, fig. 46.
- CYCLOLINA IMPRESSA, *Egger*, 1857. Neues Jahrb. f. Min., &c., p. 304, pl. x, figs. 7, 8.
- SPIRILLINA PERFORATA, *Williamson*, 1858. Rec. For. Gt. Br., p. 92, pl. vii, fig. 202.
- VIVIPARA, *P. and J.*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 303, No. 86.
- — — 1865. Phil. Trans., vol. clv, p. 397, pl. xv, fig. 28.
- PERFORATA, *Alcock*, 1865. Proc. Lit. Phil. Soc. Manchester, vol. iv, p. 206.
- — *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 74 (16 of Cat.).
- VIVIPARA, *P. and J.*, 1872. Ann. Mag. N. H., ser. 4, vol. ix, p. 221.
- — *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 55.
- — *Möbius*, 1880. Foram. Mauritius, p. 88, pl. viii, figs. 1, 2 (a single row of pores near the outer wall on the older whorls).
- — *Brady*, 1884. Report 'Challenger,' p. 630, pl. lxxxv, figs. 1—5.
- OBCONICA, *Brady*, 1884. Ibid., figs. 6, 7 (a medial row of pores).
- VIVIPARA, *Balkwill and Wright*, 1885. Tr. R. I. Ac., vol. xxviii (Sci.), p. 348, pl. xii, fig. 32.
- IMPRESSA, *Gümbel*, 1885. Geol. Bayern, vol. i, part 2, p. 421, fig. 266 13.
- VIVIPARA, *Brady*, 1887. Journ. R. Micr. Soc., p. 917.
- — *Häusler*, 1890. Abh. Schweiz. Pal. Ges., vol. xvii, p. 122, pl. xv, fig. 49.
- MINIMA, *Schacko*, 1892. Arch. Freund. Nat. Mecklenburg, Jahr. xlv (for 1891), p. 159, pl. o, figs. 4 a, b.
- VIVIPARA, *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, p. 394, pl. xviii, figs. 56—58.

*Characters.*—In the type-form the shell is discoidal, thin, sometimes concave in the middle; rounded on the edge, the whorls being sub-cylindrical, rarely embracing, but the later usually larger in diameter than the earliest; bearing numerous conspicuous foramina.

The variety here figured differs from the type-form in being marked by a single row of impressions or perforations along the inner edge of the sub-cylindrical tubular whorls. We had prepared to call it *unilinearis*, but Dr. G. Schacko, of Berlin, has figured and described a very similar, if not identical form, as above quoted. The large perforations along the suture-line, besides the fine general perforation, are characteristic. The apparent granulation of the surface in his specimen M. Schacko attributes to a partial decalcification of the shell.

*Occurrence.*—*Spirillina vivipara* (with its varieties) has a world-wide distribution in comparatively shallow waters. The lowest depth from which specimens were obtained by the 'Challenger' was 620 fathoms.

Fossil specimens are comparatively rare. It has been obtained from the Miocene of Vienna and Lower Bavaria, the Pliocene of St. Erth, and the Pleistocene of Ireland. In the Coralline Crag we have specimens of the type-form or varieties from nearly every zone examined. Fig. 22 represents a specimen from Broom Hill. Dr. Schacko describes his *Sp. minima* as being abundant in the Chalk of Rugen.

1\*\*. SPIRILLINA VIVIPARA, *Ehrenberg*, 1841, var. COMPLANATA, nov. Plate III, figs. 20—22.

Part I, 1866 (" *Spirillina vivipara* "), Appendices I and II, Tables, No. 75.

In figs. 20—22 we see all the characters of *Spirillina vivipara* excepting that the edge is obliquely steep,—that is, the tube, instead of being circular in section, has an obliquely oblong sectional area, and the shell is flat above and below, the sutures being quite flush with the surface, and the whorls not at all overlapping one another.

Hence we must regard this figured specimen as a variety (var. *complanata*). The oblique periphery is seen also in Brady's *Sp. inæqualis*, Rep. 'Challenger,' p. 631, pl. lxxxv, figs. 8—11.

*Occurrence.*—For that of the type-form see above. The figured specimen (Pl. III, figs. 20—22) was collected by Mr. S. V. Wood in the Sutton Crag.

#### *Sub-family 2.*—ROTALINÆ.

Test free or, rarely, attached, somewhat ammonitiform (rotaliform), and sometimes acervuline. Aperture usually or normally a crescentic slit on the inferior face of the shell.

#### *Genus 1.*—DISCORBINA, *Parker and Jones*, 1862.

*Carpenter*, 1862, *Introd. Foram.*, p. 203; *Brady*, 1884, *Report 'Challenger,'* pp. 72, 627, 640.

ROTALITES, *Lamarck*, *Defrance*, *Blainville*.

ROTALIA, *Lamarck*, *d'Orbigny*, *von Münster*, *Römer*, *Michelotti*, *Parker and Jones*, *Morris and Quekett*.

DISCORBIS, DISCORBITES, *Lamarck*, *Defrance*, *Blainville*, *Berthelin*.

ROTULITES, *Defrance, Blainville.*

ROSALINA, *d'Orbigny, Schultze, Parker and Jones, von Reuss, Terquem.*

ANOMALINA, *d'Orbigny, von Reuss.*

TROCHULINA, *d'Orbigny.*

VALVULINA, *d'Orbigny, von Reuss.*

ASTERIGERINA, *d'Orbigny, von Reuss, Egger, Costa, Morris and Quekett, Karrer, Terquem.*

ROTALINA (pars), *von Reuss, Williamson, Alcock, Parfitt, Terquem.*

DISCORBINA, *Parker and Jones, Carpenter, Brady, von Reuss, M. Sars, Karrer, von Gümbel, Miller and Vanden Broeck, Schultze, Robertson, Winther, von Hantken, Siddall, Shone, Marsson, Wright, Möbius, Seguenza, Terrigi, Schwager, Macdonald, Goës, Howchin, Toutkowsky, Dawson, Walther, Uhlig, Olszewski, Balkwill, Wright, Morris, K. Miller, Zittel, Sherborn, Chapman, Rzehak, Bütschli, Wallich, Nicholson, Schlumberger, Quenstedt, de Folin, Millett, and others.*

*General Characters.*—Test free or adherent, rotaliform; plano-convex or trochoid, rarely complanate; aperture an arched slit, often protected by an umbilical flap,—the flaps sometimes forming a whorl of subsidiary chambers; shell coarsely porous.

# 1. DISCORBINA TURBO (*d'Orbigny*), 1826. Plate VII, figs. 29 *a—c*.

ROTALIA (TROCHULINA) TURBO, *d'Orb.*, 1826. *Ann. Sci. Nat.*, vol. vii, p. 274, No. 39; *Modèle*, No. 73.

— TURBO, *J. and P.*, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi, p. 306.

— — — 1860. *Ann. Mag. N. H.*, ser. 3, vol. v, p. 293.

DISCORBINA TURBO, *Carpenter, Parker, and Jones*, 1862. *Introd. Foram.*, pp. 204 and 311.

— — — vars., *P. and J.*, 1865. *Phil. Trans.*, vol. clv, p. 384.

— — — *P., J., and B.*, 1865. *Ann. Mag. N. H.*, ser. 3, vol. xvi, p. 30, pl. ii, fig. 68.

— SOLARIUM, *Seguenza*, 1880. *Atti R. Accad. Lincei*, ser. 3, *Memorie*, vol. vi, p. 64, pl. vii, fig. 9.

— TURBO, *Bütschli*, 1880. *Bronn's Klassen, &c.*, p. 260, pl. ix, fig. 10.

— — *Terrigi*, 1883. *Atti Accad. Pont. N. Lincei*, vol. xxxv, p. 193, pl. iii, figs. 35, 36.

— — *Brady*, 1884. *Report 'Challenger'*, p. 642, pl. lxxxvii, figs. 8 *a—c*.

— — *Gümbel*, 1885. *Geol. Bayern.*, vol. i, part 2, p. 421, fig. 266<sup>21</sup>.

ROTALIA (TROCHULINA) TURBO, *Basset*, 1885. *Ann. Soc. Sc., Char.-Inf. de 1884*, p. 162, fig. 73.

DISCORBINA TURBO, *Egger*, 1893. *Abhandl. k. Akad. Bayer. Wiss.*, vol. xviii, pt. 2, p. 389, pl. xv, figs. 42—44.



*Characters*.—Shell trochoidal, upper face conical, lower face nearly flat; many chambers visible in the spire, five to nine shown below.

*Occurrence*.—This species, which is the type of the genus, is rather rare in the recent condition. The 'Challenger' obtained specimens off Cape de Verde Islands (11 fathoms), off Ascension (420 fathoms), near Pernambuco (350 fathoms), and at Port Jackson (2 to 10 fathoms). Brady also records specimens from the coral sands of Bermuda, and from Port Stephens, New South Wales. The 'Gazelle' obtained specimens from one station only, off Mauritius (223 fathoms).

The fossil records are from the Chalk of Maestricht; the Neocomian (Bargate Beds of Surrey); the Eocene (Calcaire Grossier); the Miocene of Calabria and of Muddy Creek (Victoria); and the Pliocene of St. Erth.<sup>1</sup> In the Coralline Crag we have specimens from Tattingstone and Broom Hill, zone **d**, from Sutton, zones **c** and **f**, and from Gedgrave, zone **f**.

## 2. DISCORBINA GLOBULARIS (*d'Orbigny*), 1826. Plate VII, figs. 28 *a—c*.

- ROSALINA GLOBULARIS, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 271, pl. xiii, figs. 1—4; Modèle, No. 69.
- VARIANS, *Schultze*, 1854. Organ Polythal., p. 60, pl. iii, figs. 8—13.
- ROTALINA SEMIPORATA, *Egger*, 1857. Neues Jahrb., &c., p. 276, pl. viii, figs. 1—3.
- CONCAMERATA (young), *Williamson*, 1858. Rec. For. Gt. Br., p. 53, pl. iv, figs. 104, 105.
- DISCORBINA TURBO, var. GLOBULARIS, *Carpenter, Parker, and Jones*, 1862. Introd. For., pp. 204 and 311, pl. iii, fig. 1.
- — var. VESICULARIS, subvar. GLOBULARIS, *P. and J.*, 1865. Phil. Trans., vol. clv, p. 386, pl. xiv, figs. 20—23.
- GLOBULARIS, *P., J., and B.*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 30, pl. ii, fig. 69.
- — *Brady and Robertson*, 1870. Ibid., ser. 4, vol. vi, p. 306.
- — *Dawson*, 1874. Canad. Nat., ser. 2, vol. vii, p. 253, fig. *c*.
- — *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 191.
- — *Dawson*, 1876. Proc. Amer. Assoc. Detroit, p. 103, fig. 4 *c*.
- — *Siddall*, 1878. Proc. Chester Soc. N. Sci., No. 2, p. 55.
- ROSALINA GLOBULARIS, *Terquem*, 1878. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 25, pl. ii (vii), figs. 10 *a—c*.
- DISCORBINA GLOBULARIS, *Terrigi*, 1880. Atti Accad. Pontan. N. Lincei, vol. xxxiii, p. 201, pl. iii, fig. 56.
- — *Möbius*, 1880. Meer. Mauritius, p. 96, pl. ix, fig. 18.

<sup>1</sup> The St. Erth specimens of *D. turbo* are similar to *D. solarium* of Seguenza. The specimen from the Crag here figured seems nearer to *D. rosacea*.—F. W. M.

- DISCORBINA GLOBULARIS, *Brady*, 1884. Report 'Challenger,' pp. 627 and 643, pl. lxxxvi, figs. 8, 13.
- ROSALINA GLOBULARIS, *Basset*, 1885. Ann. Soc. Sci. Char.-Inf. de 1884, p. 169, fig. 69.
- DISCORBINA GLOBULARIS, *Brady*, 1887. Journ. R. Micr. Soc., p. 918.
- — *Walther*, 1888. Mitth. Zool. Stat. Neapol, vol. viii, p. 382, pl. xx, fig. 1.
- — *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 226, pl. xlv, figs. 6 *a—c*.
- — *Terrigi*, 1889. Mem. R. Acc. Lincei, ser. 4, vol. vi, p. 115, pl. vi, fig. 20.
- — — 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 105, pl. iv, fig. 7.
- — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, pl. xv, figs. 7—9.
- — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv, No. 9, p. 94, pl. xv, fig. 793.

*Characters*.—Helicoid shell, with low spire, showing several chambers, inflated, especially the last, sutures depressed, rarely limbate, lower face of shell nearly flat, showing about five chambers.

*Occurrence*.—*Discorbina globularis* has a wide geographical range, having been found in nearly all seas from Davis Strait in the North to Magellan's Strait in the South. It is more common in temperate and sub-tropical waters; and has not, according to the 'Challenger' Report, been yet found at depths greater than 450 fathoms.

Fossil specimens have been found in the Eocene, London Clay, and Calcaire Grossier, the Miocene of Bavaria, Southern Italy and Muddy Creek (Victoria), the Pliocene of Italy and St. Erth, and in the Pleistocene of the British Isles, Italy, and elsewhere (*Brady*). It is not a common fossil in the Coralline Crag. The figured specimen is from Tattingstone, zone **d**.

### 3. DISCORBINA ROSACEA (*d'Orbigny*), 1826. Plate IV, figs. 17 *a—c*.

Part I, 1866, Appendices I and II, Tables, No. 76.

- Ammoniaë *Planorbes*, *Soldani*, 1780. Sagg. Oritt., p. 104, pl. iii, fig. 24, m, M, N; and Test., vol. ii, Appendix, p. 140 (same figs.).
- ROTALIA ROSACEA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 273, No. 15; Modèle, No. 39.
- ASTERIGERINA PLANORBIS, *d'Orbigny*, 1846. For. Foss. Vien., p. 205, pl. xi, figs. 1—3.

## FORAMINIFERA OF THE CRAG.

- ASTERIGERINA ROSACEA, *d'Orbigny*, 1852. *Prodrome Paléont.*, vol. iii, p. 158, No. 2952.
- ROTALINA MAMILLA, *Williamson*, 1858. *Rec. For. Gt. Brit.*, p. 54, pl. iv, figs. 109—111.
- ROTALIA ROSACEA, *Jones and Parker*, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi, p. 302, No. 129 (Table).
- DISCORBINA ROSACEA, *Brady*, 1864. *Trans. Linn. Soc.*, vol. xxiv, p. 473, No. 69.
- ASTERIGERINA PLANORBIS, *Reuss*, 1864. *Sitzungsb. Ak. Wiss. Wien*, vol. l, p. 476.
- DISCORBINA TURBO, var. ROSACEA, *Parker and Jones*, 1865. *Phil. Trans.*, vol. clv, p. 385, pl. xvi, figs. 28 *a, b*.
- ROSACEA, *Parker, Jones, and Brady*, 1865. *Ann. Nat. Hist.*, ser. 3, vol. xvi, p. 25, pl. ii, fig. 71.
- — *Brady*, 1865. *Nat. Hist. Trans. Northumberland and Durham*, vol. i, p. 104, No. 2.
- ROTALINA MAMILLA, *Alcock*, 1865. *Proc. Lit. Phil. Soc. Manch.*, vol. iv, p. 206.
- DISCORBINA PLANORBIS, *Reuss*, 1866. *Denkschr. k. Akad. Wiss. Wien*, vol. xxv, p. 161.
- ROSACEA, *J., P., and B.*, 1866. *Monogr. For. Crag, Appendices*, No. 76, pl. iv, figs. 17 *a—c*.
- — *Sars*, 1868. *Vidensk-Selsk. Forhandl. for 1868*, p. 249.
- — *Brady*, 1868. (In *Crosskey and Robertson*) *Trans. Geol. Soc. Glasgow*, vol. iii, p. 125, &c.
- ROTALINA MAMILLA, *Parfitt*, 1869. *Trans. Devon. Assoc.*, vol. iii, p. 13 (?).
- DISCORBINA ROSACEA, *Brady*, 1870. *Ann. Nat. Hist.*, 4th ser., vol. vi, p. 303.
- — *Parker, Jones, and Brady*, 1871. *Ibid.*, vol. viii, p. 254.
- — *Siddall*, 1878. *Proc. Chester Soc. Nat. Sci.*, pt. 2, p. 55.
- — *Goës*, 1882. *K. Svensk. Vet.-Akad. Handl.*, vol. xix, No. 4, p. 105, pl. viii, figs. 251—257.
- — *Jones*, 1883. *Microgr. Dict.*, ed. 4, p. 267, pl. xxiv, figs. 7 *a, b*.
- — *Brady*, 1884. *Report 'Challenger'*, p. 644, pl. lxxxvii, figs. 1 and 4.
- ROTALIA ROSACEA, *Basset*, 1885. *Ann. Soc. Char.-Inf.*, vol. xxi, p. 162, fig. 39.
- DISCORBINA ROSACEA, *Sherborn and Chapman*, 1886. *Journ. R. Micr. Soc.*, ser. 2, vol. vi, p. 756, pl. xvi, figs. 11 *a, b*.
- — *Fornasini*, 1886. *Boll. Soc. Geol. Ital.*, vol. v, p. 145.
- — *Brady*, 1887. *Journ. R. Micr. Soc.*, p. 918.
- — *Egger*, 1893. *Abh. k. Bayer. Ak. Wiss.*, vol. xviii, pt. 2, p. 385, pl. xv, figs. 39—41.
- — *Fornasini*, 1894. *Foram. Coll. Soldani, Sagg. Oritt.*, p. 13.
- — *Goës*, 1894. *K. Sv. Vet.-Ak. Handb.*, vol. xxv, No. 9, p. 94, pl. xv, fig. 792.
- — *Egger*, 1895. *Jahresb. xvi, Nat. Ver. Passau*, p. 35, pl. iv, figs. 12 *a—c*.

*Characters.*—Shell trochoid, conical, composed of three to four convolutions each consisting of from four to seven segments. Segments convex on their



anterior and peripheral borders, imparting thereby a lobulate outline to the margin of the shell. Anterior border of each segment overlapping the posterior portion of that immediately in front of it. Inferiorly the outlines of the segments less distinct, usually marked by irregular sinuate lines extending from the periphery to the umbilicus or near it. Aperture a long, narrow, arched fissure on the inferior umbilical border of the ultimate segment.

*Occurrence.*—*Discorbina rosacea* is exceedingly common, and according to the 'Challenger' Report, "within certain depths it is found in almost every sea, from the shores of Shetland and the Farøe Islands on the north, to Magellan's Strait on the south. Its home is on shallow bottoms, and it becomes rare at greater depths than 250 fathoms; but occasional specimens are met with as low as 1000 fathoms." In contrast with this, Egger in his 'Gazelle' memoir records specimens from depths ranging from  $1\frac{1}{2}$  to 2740 fathoms, and the larger number of his records are from depths exceeding 1000 fathoms. The figures given by Egger in his pl. xv, however, suggest a doubt in our minds as to the proper identification of the species.

The geological distribution of *D. rosacea* extends to the Neocomian (Bargate Beds). Specimens have also been recorded from the Eocene (London Clay and Calcaire Grossier), the Miocene of Vienna, Muddy Creek (Victoria), and Italy, the Pliocene of Italy and St. Erth, and the Pleistocene of the British Islands and the Island of Ischia. In the Coralline Crag we have specimens from nearly every zone examined; and, as recorded in the First Part of this Monograph, the shell has also been found in the Upper Crag of Southwold.

#### 4. DISCORBINA ORBICULARIS (*d'Orbigny*), 1826. Plate VII, figs. 31 *a*—*c*.

DISCORBIS ORBICULARIS, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 274, No. 35.

ROSALINA ORBICULARIS, *d'Orb.*, 1847–50. Prodrome, part 2, p. 407, No. 1328.

— — (?), *Terquem*, 1876. Plage Dunkerque, p. 75, pl. ix, figs. 4 *a*, *b*.

ASTERIGERINA RHODIENSIS, *Terquem*, 1878. Mém. Soc. Géol. France, ser. 3, vol. i, p. 31, pl. iii (viii), figs. 1—4.

DISCORBIS ORBICULARIS, *Berthelin*, 1878. Ann. Soc. Ac. Nantes, ser. 5, vol. viii, p. 242, No. 63.

DISCORBINA ROSACEA, *Terrigi*, 1880. Atti Accad. Pontif. N. Lincei, vol. xxxiii, p. 200, pl. iii, figs. 54, 55.

— MINUTISSIMA, *Sequenza*, 1880. Atti R. Accad. Lincei, ser. 3, vol. vi, p. 149, pl. xiv, figs. 1, 1 *a*, 1 *b*.

— ORBICULARIS, *Brady*, 1884. Report 'Challenger,' p. 647, pl. lxxxviii, figs. 4—8.

— — *Balkwill and Millett*, 1884. Journ. Micr., vol. iii, p. 23, pl. iv, fig. 13.

- DISCORBINA ORBICULARIS*, *Balkwill and Wright*, 1885. Trans. R. Irish Acad., vol. xxviii (Sci.), p. 349, pl. xiii, figs. 31—33.
- — *Brady*, 1887. Journ. R. Micr. Soc., p. 918.
- — *Brady, Parker, and Jones*, 1888. Trans. Zool. Soc., vol. xii, pt. 7, p. 227, pl. xlv, fig. 1.
- — *Terrigi*, 1889. Mem. R. Accad. Lincei, ser. 4, vol. vi, p. 115, pl. vii, figs. 2, 3.
- — *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, pt. 2, p. 389, pl. xv, figs. 16—18, 76—78.
- — *Goës*, 1896. Bull. Mus. C. Z. Harvard Coll., vol. xxix, p. 69.

*Characters*.—Test thin, depressed, slightly conical above, flat or nearly so below. The upper face shows numerous, long, narrow, curved, and overlapping chambers; the last the longest. Sutures usually simple, sometimes slightly limbate. On the lower face only three or four chambers visible, the last much the largest. Umbilical flaps present.

*Occurrence*.—*Discorbina orbicularis* has a very wide geographical and bathymetrical range, but it has not hitherto been found in Arctic or Antarctic waters. The Irish Sea appears to be the most northern limit known. The 'Challenger' Report states that it is plentiful in the shallow water among the Pacific Islands, and also amongst the West Indies. Egger, in his 'Gazelle' Memoir, records it from the Cape Verde Islands and other points off the West Coast of Africa, Mauritius, Western Australia, and the Atlantic Ocean. The greatest depths recorded in the 'Challenger' Report is 435 fathoms; but the 'Gazelle' obtained specimens from a depth of 2590 fathoms in the South Atlantic Ocean.

As a fossil it has been recorded from the Neocomian (Bargate Beds of Surrey), the Miocene of Italy and Muddy Creek (Victoria), and the Pliocene of Italy and St. Erth. In the Coralline Crag we have found it in every zone examined.

##### 5. *DISCORBINA PARISIENSIS* (*d'Orbigny*), 1826. Plate II, figs. 13—15.

Part I, 1866; Appendices I and II, Tables, No. 77.

*ROSALINA PARISIENSIS*, *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 271, No. 5; Modèle, No. 38.

*DISCORBINA PARISIENSIS*, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., ser. 3, vol. xvi, p. 25, pl. 2, fig. 70.

— — *J., P., and B.*, 1866. Monogr. For. Crag, App. i and ii, Tables, No. 77, pl. ii, figs. 13—15.

- DISCORBINA PARISIENSIS, *Morris*, 1876. Lect. Geol. Croydon, p. 8, figs. 3 and 7.  
 — — — *Wright*, 1877. Proc. Belfast Field Club for 1876-7,  
 Appendix, p. 105, pl. iv, figs. 1 *a-d*  
 (not 2 *a-c*).  
 DISCORBIS PARISIENSIS, *Berthelin*, 1878. Ann. Soc. Ac. Nantes, ser. 5, vol. viii,  
 p. 242, No. 65.  
 ROSALINA PARISIENSIS, *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii,  
 p. 99, pl. x (xviii), figs. 15-17.  
 DISCORBINA PARISIENSIS, *Brady*, 1884. Rep. 'Challenger,' pp. 627 and 648, pl. xc,  
 figs. 5, 6, 9-12.  
 — — — 1887. Journ. R. Micr. Soc., p. 919.  
 — — — *Egger*, 1893. Abhandl. k. Ak. Bayer. Wiss., vol. xviii,  
 part 2, p. 391, pl. xv, figs. 25-30.  
 — — — *Goës*, 1894. K. Svensk. Vet.-Ak. Handl., vol. xxv,  
 No. 9, p. 93, pl. xv, fig. 791.

*Characters*.—Shell plano-convex, sometimes with an obtusely pointed apex; consisting of two or three convolutions of long, oblique, arcuate chambers, seven to nine in a convolution; inferiorly the segments of the last convolution extend to the umbilicus. Upper surface smooth; the last and the earlier chambers variously exposed in different specimens; the sutures simple; the lower face of the shell shows several curved and some intercalated chambers, and is ornamented with radiating lines of minute tubercles. Peripheral margin thin, rarely lobulate.

*Occurrence*.—*Discorbina parisiensis* is generally of rare occurrence in the recent condition, and appears to have a somewhat restricted range; but it is not uncommon in the shore-sand of Mount's Bay, Cornwall (Millett). The 'Challenger' found specimens only off Kerguelen at depths of 20 to 50 fathoms. The 'Gazelle' found specimens off Kerguelen, and also off Mauritius (70 to 220 fathoms); off South-West Australia (2159 fathoms); and off West Australia at less depths. Specimens have also been obtained in shallow water off the coasts of Ireland and France.

The earliest record of the species in a fossil condition is from the Neocomian (Bargate Beds) of Surrey. It has also been found in the Eocene (Calcaire Grossier), and in the Pliocene of St. Erth. We have specimens in our own collections from the Casterlian and Scaldisian of the Kattendyk Docks, Antwerp. In the Coralline Crag we have found it in every zone examined, and it has also been obtained (small and rare), as stated in the First Part of this Monograph, from the Red Crag.

6. DISCORBINA LINGULATA, sp. nov. *Burrows and Holland*. Plate VII, figs. 33 *a-c*.

DISCORBINA BICONCAVA, *Brady*, 1884. Report 'Challenger,' p. 653, pl. xci, fig. 3  
 (not fig. 2).



*Characters.*—Test compressed, flat or concavo-convex; periphery somewhat square; sutures more or less limbate on the aboral ("superior") face, and having interlocking angles on the oral face. The aboral surface of several of the chambers ornamented with a slightly raised boss.

We think Brady mistaken in admitting fig. 3 on pl. xci of the 'Challenger' Report as *D. biconcava*, *P.* and *J.* It has limbate sutures upon one side only, is not biconcave, and has not a square limbate periphery. The aboral face (fig. 3 *a*) is strikingly like our fig. 33 *a*, Pl. VII, and also like our specimens from the Miocene of Muddy Creek (Victoria).

*Occurrence.*—The figured specimen is from the Coralline Crag of Sutton, zone **f**; and, as mentioned above, we have specimens from the Miocene of Australia exactly corresponding with the specimen from the Crag.

*Genus 2.*—PLANORBULINA, *d'Orbigny*, 1826.

*Carpenter, Parker, and Jones, Introd. Foram.*, 1862, p. 206; *Brady, Report 'Challenger,'* 1884, pp. 627, 655, 656.

PLANORBULINA, emended by *Carpenter, Parker, and Jones*, comprised *Planorbulina*, *Truncatulina*, *Anomalina*, *Siphonina*, and *Planulina* of authors.

PLANORBULINA, *d'Orbigny*, *Bronn, von Münster, Römer, von Hagenow, von Reuss, Costa, Williamson, Parker and Jones, Carpenter, Karrer, Brady, M. Sars, Fischer, Schulze, Terquem, von Zittel, Schwager, Bütschli, Terrigi, Quenstedt, Basset, Carter, Fornasini, Millett, Egger, Goës, Balkwill and Wright, and others.*

*General Characters.*—Test usually adherent; flattened; chambers numerous, at first spiral, then cyclical, sometimes irregular and acervuline; apertures opening on the periphery and lipped. Shell-wall coarsely perforate.

1. PLANORBULINA MEDITERRANENSIS (*d'Orbigny*), 1826. Plate II, fig. 3; Plate V, fig. 30.

Part I, 1866, Appendices I and II, Tables, No. 78.

Corpuscula *plano-papillosa*, *Soldani*, 1795. Testaceographia, vol. i, pt. iii, p. 238, pl. 161, figs. *E, F, G*; pl. 162, fig. *H*.

PLANORBULINA MEDITERRANENSIS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 280, No. 2, pl. xiv, figs. 4—6 *bis*; Modèle, No. 79.

— DIFFORMIS, *Römer*, 1838. Neues Jahrb. für Min., p. 390, pl. iii, fig. 59.

- PLANORBULINA VULGARIS, *d'Orb.*, 1839. Foram. Cuba, p. 85, pl. vi, figs. 11—15.
- — — 1839. Foram. Canaries, p. 134, pl. ii, fig. 30.
- — *Reuss*, 1845-6. *Geinitz's Grundriss, &c.*, p. 675, pl. xxiv, fig. 44.
- MEDITERRANENSIS, *d'Orb.*, 1846. For. Foss. Vien., p. 166, pl. ix, figs. 15—17.
- — *Williamson*, 1847 and 1872. Mem. Lit. Phil. Soc. Manchester, vol. viii, pp. 36, 43, pl. ii, figs. 27—29 ("*Rosalina globularis*"); and *ibid.*, ser. 3, vol. v, pp. 133, 134.
- — *Costa*, 1856. Atti Acc. Pontan., vol. vii, pt. 2, p. 244, pl. xx, fig. 7.
- VULGARIS, *Williamson*, 1858. Rec. For. Gt. Brit., p. 57, pl. v, figs. 119, 120.
- MEDITERRANENSIS, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, Table, No. 98.
- VULGARIS, *Carpenter*, 1862. Introd. Foram., p. 208, pl. xiii, figs. 13—15.
- MEDITERRANENSIS, *Parker and Jones*, 1863. Ann. Nat. Hist., ser. 3, vol. xii, p. 440, No. 17.
- — *Karrer*, 1864. Sitzungsab. k. Akad. Wiss. Wien, vol. I, p. 721.
- — *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 473, No. 73.
- — *Parker, Jones, and Brady*, 1865. Ann. Nat. Hist., ser. 3, vol. xvi, p. 31, pl. ii, fig. 74.
- FARCTA, var. MEDITERRANENSIS, *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 383, pl. xvi, fig. 21.
- MEDITERRANENSIS, *Brady*, 1865. Nat. Hist. Trans. Northd. and Durham, vol. i, p. 104, No. 1.
- MEDITERRANEA, *Reuss*, 1865. Model, No. 79 (Catal., 1861, No. 90).
- MEDITERRANENSIS, *J., P., and B.*, 1866. Monogr. For. Crag, Append. I and II, No. 78, pl. ii, fig. 3.
- — *Brady*, 1868. Proceed. Phil. Soc. Glasgow, vi, p. 357; Trans. Geol. Soc. Glasgow, vol. iii, p. 127.
- — *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
- MEDITERRANEA, *Reuss*, 1869. Sitzungs. Ak. k. Wiss. Wien, vol. lix, p. 460.
- MEDITERRANENSIS, *Brady and Robertson*, 1870. Ann. Nat. Hist., ser. 4, vol. vi, pp. 303, 306.
- — *Parker, Jones, and Brady*, 1871. *Ibid.*, vol. viii, p. 178, pl. xii, fig. 133.

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- PLANORBULINA MEDITERRANENSIS, *Jones and Parker*, 1872. Quart. Journ. Geol. Soc., vol. xxviii, p. 119.
- — — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
- VULGARIS, *Terquem*, 1875. Plage Dunkerque, p. 30, pl. iv, fig. 1.
- DISTOMA, *Terquem*, 1876. Ibid., p. 73, pl. viii, fig. 11.
- INFLATA, *Terquem*, 1876. Ibid., p. 74, pl. viii, fig. 12.
- RADIATA, *Terquem*, 1876. Ibid., p. 74, pl. viii, fig. 13.
- MEDITERRANENSIS, *Zittel*, 1876. Handb. Pal., part 1, p. 93, fig. 30<sup>2</sup>.
- — — *Schwager*, 1877. Boll. R. Com. Geol. Ital., p. 26, fig. 55.
- VULGARIS, *Carter*, 1877. Ann. Mag. Nat. Hist., ser. 4, vol. xix, p. 218, pl. xiii, fig. 17.
- MEDITERRANENSIS, *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., part 2, p. 55.
- — — *Bütschli*, 1880. Bronn's Klassen, &c., p. 206, pl. ix, fig. 8.
- FARCTA, var. VULGARIS, *Goës*, 1882. K. Sv. V.-Ak. Handl., vol. xix, No. 4, p. 97, pl. vii, figs. 226 (f), 227.
- NODOSA, *Terquem*, 1882. Mém. Soc. Géol. Fr., ser. 3, vol. ii, p. 91, pl. xvii, fig. 16.
- VICINALIS, *Terquem*, 1882. Ibid., p. 90, pl. xvii, fig. 14.
- MEDITERRANENSIS, *Jones*, 1883. Microgr. Dict., ed. 4, p. 605, pl. xxiv, fig. 10.
- — — *Terrigi*, 1883. Atti Acc. Pont. Lincei, vol. xxxv, p. 194, pl. iii, fig. 38.
- — — *Brady*, 1884. Report 'Challenger,' p. 656, pl. xcii, figs. 1—3.
- — — *Basset*, 1885. Ann. Soc. Sci. Char.-Inf. de 1884, p. 162, fig. 79.
- — — *Quenstedt*, 1885. Handb. Petref., ed. 3, pt. 5, p. 1058, pl. lxxxvi, fig. 50.
- — — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 224, 225.
- — — *Brady*, 1887. Journ. R. Micr. Soc., p. 920.
- — — *B., P., and J.*, 1888. Tr. Zool. Soc., vol. xii, part vii, p. 227, pl. xlv, figs. 18 a, b.
- — — (MEDITERRANEA in Expl. of plate), *Egger*, 1893. Abhandl. k. Bayer. Akad. Wiss., vol. xviii, pt. 2, p. 380, pl. xiv, figs. 24—26 (young form).
- — — *Goës*, 1894. K. Sv. V.-Akad. Handl., vol. xxv, No. 9, p. 91, pl. xv, fig. 786.



- PLANORBULINA MEDITERRANENSIS, *Egger*, 1895. *Jahresb. xvi, Nat. Ver. Passau*,  
p. 32, pl. v, figs. 12, 13.  
— — — — — *Goës*, 1896. *Bull. Mus. C. Z. Harvard Coll.*,  
vol. xxix, p. 73.

*Characters*.—Shell free at first, parasitic afterwards, thin, outspread, one face ("superior" and attached), somewhat flatter than the other; the periphery almost circular, subangular, or irregular. Chambers numerous, inflated, arranged sub-cyclically on one plane; early spiral chambers visible in the middle of the attached face; septal orifices somewhat obscure, but usually at both ends of the outer chambers on the periphery.

Pl. II, fig. 3, represents a feeble individual of the Northern form *vulgaris*.

*Occurrence*.—According to the 'Challenger' Report, this species occurs "in almost every sea within the temperate and tropical zones." It is commonest at depths of less than 50 fathoms, but one specimen has been found at a depth of 1125 fathoms. *Egger* in his 'Gazelle' Memoir records the occurrence of rare specimens at one station off Kerguelen Island.

Fossil specimens have been obtained from the Oligocene of Elsass, the Miocene of Vienna and Muddy Creek (Victoria), the Pliocene of Italy, Antwerp (Casterlian), and St. Erth, and in the Pleistocene of many localities. In the Coralline Crag we have examples from every zone examined.

#### Genus 4.—TRUNCATULINA, *d'Orbigny*, 1826.

*Brady*, Report 'Challenger,' 1884, pp. 73, 655, and 658.

NAUTILUS, *Walker and Boys, Fichtel and Moll, Maton and Rackett, Turton, Pennant, Dillwyn.*

SERPULA, *Montagu.*

ROTALIA, *Lamarck, d'Orbigny, Römer, von Reuss, Karrer, Stache, von Gümbel.*

POLYXENES, *de Montfort.*

CIBICIDES, *de Montfort, Blainville.*

CRISTELLARIA, *Lamarck.*

TRUNCATULINA, *d'Orbigny, Bronn, von Münster, Römer, von Reuss, Costa, Egger, Parker and Jones, Williamson, Karrer, Sequenza, Brady, G. M. and J. W. Dawson, M. Sars, von Hantken, Winther, Wright, Terquem, Toutkowsky, Andreae, Ehrenberg, Terrigi, Malagoli, Schwager, Uhlig, Karrer, von Gümbel, Gosse, Mantell, Pictet, Carpenter, Marsson, Hopkins, Nicholson, Sherborn Chapman,*

*Rzehak, von Hagenow, Mackie, Schultze, Wright, Wood, von Schlicht, Millett, A. Silvestri, Grzybowski, and others.*

LOBATULA, *Fleming, Thorpe.*

ROSALINA, *d'Orbigny, Alth, von Reuss, Stache, von Gümbel.*

ROTALINA, *d'Orbigny, Czjzek, von Reuss, Bailey, Bornemann, Egger, Karrer, Seguenza, Martonfi.*

DISCORBIS, *Macgillivray.*

ANOMALINA, *d'Orbigny, Schwager.*

SIPHONINA, *von Reuss, Costa, Karrer, Terrigi, Seguenza.*

PLANORBULINA, *Parker and Jones, Carpenter, Brady, Siddall.*

*General Characters.*—Free or adherent, rotaliform; generally more convex on the oral surface. Shell-wall coarsely porous; surface often tuberculate; aperture a curved slit at the inner edge of the last segment, sometimes with an elongate neck and lip.

# 1. TRUNCATULINA REFULGENS (*Montfort*), 1808. Plate V, figs. 31 *a*, 31 *b*.

Part I, 1866, Appendices I and II, Tables, No. 82.

*Hammonia Balanus* seu *Balanoidea*, *Soldani*, 1789. Testaceographia, vol. i, pt. 1, p. 58, pl. xlv, figs. *nn*, *oó*.

CIBICIDES REFULGENS, *Montfort*, 1808. Conchyl. Syst., vol. i, p. 122, 31re genre.

— — *DeFrance*, 1824 (*fide* *Blainville*). Dict. Sci. Nat., vol. ix, p. 188; vol. xix, p. 2; vol. xxxii, p. 187; Atlas Conch., pl. xix, fig. 2.

— — *Blainville*, 1825. Manuel Malacol., p. 391, pl. x, fig. 2.

TRUNCATULINA REFULGENS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 279, No. 5, pl. xiii, figs. 8—11; Modèle, No. 77.

PLANORBULINA (TRUNCATULINA) REFULGENS, *Jones and Parker*, 1860. Q. J. Geol. Soc., vol. xvi, p. 302, No. 100 (Table).

TRUNCATULINA REFULGENS, *Parker and Jones*, 1860. Ann. Mag. Nat. Hist., 3 ser., vol. vi, p. 340, No. 17.

— — — 1863. Ibid., vol. xii, p. 202, No. 3, p. 437, No. 62.

— — *Carpenter*, 1862. Introd. Foram., p. 201, fig. xxxii, E.

— — *Brady*, 1865. Nat. Hist. Trans. Northld. and Durham, vol. i, p. 105, pl. xii, fig. 9.

— — *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., 3 ser., vol. xvi, p. 31, pl. ii, fig. 76.

-- LOBATULA (passing into REFULGENS), *Parker and Jones*, 1865. Phil. Trans., vol. clv, p. 382, pi. xvi, figs. 18—20.

- TRUNCATULINA REFULGENS, *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, App. I and II, No. 82.
- — *Sars*, 1868. Vidensk-Selsk. Forhandl. for 1868, p. 248.
- — *Brady*, 1868. Proc. Geol. Soc. Glasgow, vol. vi, p. 362.
- — *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, p. 303.
- — *P., J., and B.*, 1871. Ibid., ser. 4, vol. viii, p. 176, pl. xii, fig. 139.
- — *Brady and Robertson*, 1875. Brit. Assoc. Rep. for 1874, p. 191.
- — *Terrigi*, 1883. Att. Acc. P. N. Lincei, vol. xxxv, p. 197, pl. iii, fig. 40.
- — *Brady*, 1884. Report 'Challenger,' p. 659, pl. xcii, figs. 7—9.
- — *Basset*, 1885. Ann. Soc. Sci. N. Char.-Inf., No. 21, p. 162, fig. 77.
- — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 167, 168.
- — *Sherborn and Chapman*, 1886. Journ. Roy. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 13 a—c.
- — *Brady*, 1887. Ibid., vol. vii, p. 920.
- — *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, p. 401, pl. xvi, figs. 31—33.
- PLANORBULINA REFULGENS, *Goës*, 1894. K. Sven. Vet.-Akad. Handl., vol. xxv, No. 9, p. 89, pl. xv, figs. 775, 776.

*Characters*.—Shell free or parasitic, regular; conical or plano-convex. Oral surface conical or dome-shaped, aboral surface flat or slightly concave; chambers long, arcuate, somewhat inflated. Foramina inconspicuous.

This is but an exaggerated condition of *Tr. lobatula* in which the convexity of the oral surface is increased, sometimes so much as to give the shell the form of a tall cone. The pseudopodial perforations are commonly obliterated by the free deposit of shell-substance. In other respects the characters of *Tr. lobatula* apply equally to *Tr. refulgens*.

*Occurrence*.—*Truncatulina refulgens*, according to the 'Challenger' Report, is confined to temperate seas, and occurs at depths of from 45 to 2400 fathoms. Egger in his 'Gazelle' Memoir records specimens from off Mauritius and North Australia at depths of 74 and 194 fathoms respectively.

Fossil specimens have been obtained from the London Clay, the Pliocene of Southern Italy, and from the Pleistocene of Ireland. In the Coralline Crag we have specimens from Tattingstone, Sudbourne, and Broom Hill (zone d), and from Aldborough (zone g). It has also been recorded in the First Part of the Monograph from the Red Crag.



2. TRUNCATULINA LOBATULA (*Walker*), 1784. Plate II, figs. 4—10; Plate IV, fig. 19.

Part I, 1866, Appendices I and II, Tables, No. 81.

*Ammonia Plano-convexa*, *Soldani*, 1780. Saggio Oritt., p. 104, pl. iii, figs. 26, q, r.NAUTILUS LOBATULUS, *Walker*, 1784. Test. Min., p. 20, pl. iii, fig. 71.*Ammonia tuberculata*, pseudoparasitica, &c., *Soldani*, 1789. Testaceographia, vol. i, pt. 1, p. 58, pl. xlv, figs. gg, hh, ii, kk, ll, mm.[We may note that, besides these figures of the more common aspect of *Tr. lobatula*, nearly all the figures in pls. xli, xlii, xliii, xlv, and xlv, described by *Soldani* at pp. 57, 58, represent various modifications of the same sub-type.]*Ammonia Plano-convexa*, *Soldani*, 1798. Ibid., vol. ii, App., p. 140, pl. iii, fig. 26 q, Q, R.NAUTILUS LOBATULUS, *Walker and Jacob*, 1798 (*vide* Kanmacher). Adams's Essays, 2nd edit., p. 642, pl. xiv, fig. 36.— — — *Turton*, 1800–6. Linn. Syst. Nat., vol. iv, p. 307.SERPULA LOBATULA, *Montagu*, 1803, 1809. Test. Brit., p. 515; 1809, Supplement, p. 160.NAUTILUS LOBATULUS, *Pennant*, 1812. Brit. Zool., vol. iv, p. 248.— — — *Maton and Rackett*, 1807. Trans. Linn. Soc., vol. viii, p. 117.— — — *Dillwyn*, 1817. Descr. Cat., vol. i, p. 343.— — — *Turton*, 1819. Conch. Dict., p. 120.— — — *Wood*, 1825. Index Testac., p. 64, pl. xiii, fig. 13.TRUNCATULINA TUBERCULATA, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 279, No. 1; Modèle, No. 37.PLANULINA INCERTA (? young), *d'Orbigny*, 1826. Ibid., p. 280, No. 3.TRUNCATULINA TUBERCULATA, *Risso*, 1826. Hist. Nat. Europ. Mérid., vol. iv, p. 19, No. 46.LOBATULA VULGARIS, *Fleming*, 1828. Brit. Anim., p. 232.TRUNCATULINA COMMUNIS, *Römer*, 1838. Neues Jahrb., &c., Jahrg. 1838, p. 389, pl. iii, fig. 56.[Not described], *Costa*, 1838. Fauna Regno Napoli, pl. iii, fig. 8.TRUNCATULINA ADVENA, *d'Orb.*, 1839. Foram. Cuba, p. 87, pl. vi, figs. 3—5.— — — DISPARS, *d'Orb.*, 1839. Foram. Amér. Mérid., p. 38, pl. v, figs. 25—27.— — — DEPRESSA, *d'Orb.*, 1839. Ibid., p. 39, pl. vi, figs. 4—6 (thin).— — — LOBATA, *d'Orb.*, 1839. Foram. Canaries, p. 134, pl. ii, figs. 22—24.— — — LEVIGATA, *Römer*, 1841. Verstein. Norddentsch. Kreid., p. 97, pl. xv, fig. 23.DISCORBIS LOBATULUS, *Macgillivray*, 1843. Moll. Anim. Aberd., p. 34.LOBATULA VULGARIS, *Thorpe*, 1844. Brit. Mar. Conch., p. 235.TRUNCATULINA COMMUNIS, *Philippi*, 1844. Beit. Kennt. Tertiärverstein., p. 42, No. 31.

- TRUNCATULINA LÆVIGATA, *Reuss*, 1845. Verstein. Böhm. Kreid., p. 37, pl. viii, fig. 71; and pl. xiii, fig. 47.
- LOBATULA, *d'Orb.*, 1846. For. Foss. Vien., p. 168, pl. ix, figs. 18—23.
- BOUEANA, *d'Orb.*, 1846. Ibid., p. 169, pl. ix, figs. 24—26.
- ANOMALINA VARIOLATA (VARIOLARIA on the plate), *d'Orb.* Ibid., p. 170, pl. ix, figs. 27—29.
- TRUNCATULINA LOBATULA, *Williamson*, 1847 and 1872. Mem. Lit. Phil. Soc. Manch., vol. viii, p. 46, pl. iii, fig. 35 ("tuberculata"); ibid., ser. 3, vol. v, p. 134.
- ROSALINA GALICIANA, *Alth*, 1850. Haidingers Naturwiss. Abhand., vol. iii, p. 265, pl. xiii, fig. 20.
- TRUNCATULINA BOUEANA, *Reuss*, 1851. Zeitsch. Deutsch. Geol. Gesellsch., vol. iii, p. 158, No. 40.
- LOBATULA, *Reuss*, 1851. Ibid., No. 41.
- — *Bronn*, 1853–56. Leth. Geogn., edit. 3, part 3, p. 224, pl. xxxv<sup>2</sup>, figs. 16 a, b, c.
- — *Gosse*, 1855. Man. Mar. Zool., p. 12, fig. 20.
- RODALIA DEPLANATA, *Reuss*, 1855. Zeitschr. Deutsch. Geol. Gesellsch., vol. vii, p. 288, pl. xi, fig. 3.
- TRUNCATULINA CONCINNA, *Reuss*, 1855. Ibid., fig. 4.
- LOBATULA, *Reuss*, 1855. Sitzungsbr. k. Ak. Wiss. Wien, vol. xviii, pp. 203, 208, &c.
- COMMUNIS, *Reuss*, 1855. Ibid., p. 242, pl. v, fig. 56.
- LOBATULA, *Costa*, 1856. Atti Acc. Pont., vol. vii, part 2, p. 249, pl. xiv, figs. 7 A, B; pl. xx, fig. 12 (*alternans* at p. 250).
- [indet.], *Mantell*, 1857. Wonders Geol., ed. 7, p. 253, lign. 45.
- LOBATULA, *Pictet*, 1857. Traité Pal., ed. 2, vol. iv, p. 510, pl. cix, fig. 30.
- — *Egger*, 1857. Neues Jahrb., &c., Jahrg. 1857, p. 279, pl. ix, figs. 1—3.
- — *Parker and Jones*, 1857. Ann. Mag. Nat. Hist., 2 ser., vol. xix, p. 293, pl. x, figs. 17—21.
- — *Williamson*, 1858. Rec. For. Gt. Br., p. 59, pl. v, figs. 121—123.
- — *Parker and Jones*, 1859. Ann. Mag. Nat. Hist., 3 ser., vol. iv, pp. 339 and 348.
- — *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi, p. 302, No. 99 (Table).
- VARIANS, *Reuss*, 1860. Sitz. k. Ak. Wiss. Wien, vol. xlii, p. 359, pl. ii, figs. 12 a, b, c.
- DEKAYI, *Reuss*, 1861. Ibid., vol. xliv, p. 338, pl. vii, fig. 6.
- ROSALINA BOSQUETI, *Reuss*, 1861. Ibid., p. 316, pl. iii, fig. 1.
- TRUNCATULINA LOBATULA, *Karrer*, 1861. Ibid., p. 455, No. 129, Table.
- — *Carpenter*, 1862. Introd. Foram., p. 201, fig. xxxii B, pl. iv, fig. 5.

- TRUNCATULINA LOBATULA, *Karrer*, 1863. Sitz. Ak. Wiss. Wien, vol. xlviii, p. 101.
- — — 1864. Ibid., vol. l, pp. 694 and 720.
- — *Reuss*, 1864. Ibid., p. 477.
- COMMUNIS, *Reuss*, 1864. Ibid., p. 477.
- PLANORBULINA (TRUNCATULINA) LOBATULA, *Jones and Parker*, 1864. Geologist, vol. vii, p. 87.
- TRUNCATULINA LOBATULA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 474, No. 76.
- — — 1865. Nat. Hist. Trans. Northld. and Durham, vol. i, p. 105, No. 1.
- PLANORBULINA FARCTA, var. (TRUNCATULINA) LOBATULA, *Parker and Jones*, 1865, Phil. Trans., vol. clv, p. 381, pl. xiv, figs. 3—6; pl. xvi, figs. 18—20.
- TRUNCATULINA LOBATULA, *Parker, Jones, and Brady*, 1865. Ann. Mag. Nat. Hist., 3 ser., vol. xvi, p. 25, pl. ii, fig. 77.
- — *Sars*, 1865. Foss. Dyrelevn. Quartærperioden, p. 10, &c.
- — *Jones, Parker, and Brady*, 1866. Monogr. Foram. Crag, Appendices, pl. ii, figs. 4—10; pl. iv, fig. 19.
- COMMUNIS, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv, p. 159.
- BOUEANA, *Reuss*, 1866. Ibid., p. 159.
- LOBATULA, *Reuss*, 1867. Sitzungsab. k. Ak. Wiss. Wien, vol. lv, p. 99.
- — *Karrer*, 1868. Ibid., vol. lviii, p. 181, No. 6.
- — *Karrer and Fuchs*, 1868. Jahrb. Geol. Reichsanst., Jahrg. 1868, p. 579, &c.
- — *Fuchs and Karrer*, 1868. Ibid., p. 270.
- — *Brady*, 1868. (In Crosskey and Robertson) Proc. Phil. Soc. Glasgow, vol. vi, p. 351, &c.
- — *Sars*, 1869. Forhandl. Vidensk.-Selsk. for 1868, p. 248.
- — *Parfitt*, 1869. Trans. Devon. Assoc., vol. iii, p. 71.
- — *J. W. Dawson*, 1869. Canad. Nat., n. s., vol. iv, p. 416, fig. 35.
- — *G. M. Dawson*, 1870. Ibid., vol. v, p. 179.
- — *Brady and Robertson*, 1870. Ann. Mag. Nat. Hist., ser. 4, vol. vi, pp. 303, 306.
- DISCORBINA DANUBIA, *Karrer*, 1870. Jahrb. k.-k. Geol. Reichsanst., Jahrg. 1870, p. 184, pl. ii, fig. 15.
- TRUNCATULINA LOBATULA, *Parker, Jones, and Brady*, 1871. Ibid., vol. viii, pp. 176, 177, Nos. 86, 90, pl. xii, figs. 136, 137.
- — *Fuchs and Karrer*, 1871. Jahrb. k. k. Geol. Reichsanst., vol. xxi, pp. 70, 71, &c.
- — *Jones and Parker*, 1872. Quart. Journ. Geol. Soc., vol. xxviii, p. 119.
- — *J. W. Dawson*, 1872. Canad. Nat., n. s., vol. vi, p. 255, pl. iii, fig. 3.



- TRUNCATULINA LOBATULA, *Brady and Robertson*, 1875. Rep. Brit. Assoc. for 1874, p. 191.
- — *Terquem*, 1875. Plage Dunkerque, fasc. 1, p. 30, pl. iv, figs. 2 *a—c*.
- — *Vanden Broeck*, 1876. Mém. Soc. Belg. Microsc., vol. ii, p. 138.
- — *Schwager*, 1877. Boll. R. Com. Geol. Ital., vol. viii, p. 26, fig. 49.
- — *Marsson*, 1878. Mitth. nat. Ver. Neu-Vorpom., vol. x, p. 167, pl. v, figs. 38 *a—g*.
- — *Siddall*, 1878. Proc. Chester Soc. Nat. Sci., part 2, p. 55.
- — *Vine*, 1878. Science Gossip, p. 52, figs. 39, 40.
- [indet.], *Hopkins*, 1878–9. Congr. Sess. 3, vol. iv, Rep., pt. 2, App. iv, p. 885, pl. i, fig. 65.
- LOBATULA, *Nicholson*, 1879. Man. Palæont., vol. i, p. 117, fig. 18 *p*.
- — *Terrigi*, 1880. Atti Acc. Pont. Linc., vol. xxxiii, p. 205, pl. iii, fig. 57.
- — *Terquem*, 1881. Plage Dunkerque (3), p. 126, pl. xvi, figs. 4 *a—c*.
- — var. UMBILICATA, *Terquem*, 1881. Ibid., figs. 5 *a—c*.
- — *Terquem*, 1882. Mém. Soc. Géol. France, ser. 3, vol. ii, No. 3, p. 94, pl. ix (xvii), figs. 27 *a, b*.
- PLANORBULINA FABCTA, *Goës* (?), 1882. K. Svensk. Vet.-Ak. Handl., vol. xix, No. 4, p. 96, pl. vii, figs. 220–225.
- TRUNCATULINA LOBATULA, *Jones*, 1883. Microgr. Dict., ed. 4, p. 784, pl. xxiv, figs. 9 *a, b*.
- — *Brady*, 1884. Report 'Challenger,' pp. 627, 660, pl. xcii, fig. 10; pl. xciii, figs. 1, 4, 5; pl. cxv, figs. 4, 5.
- TUBERCULATA, *Bassett*, 1884. Ann. Soc. Sci. Nat. Char.-Inf., No. 21, p. 162, fig. 37.
- LOBULATA, *Gümbel*, 1885. Geol. Bayern., vol. i, part 2, p. 421, fig. 266.
- — *Sir J. W. Dawson*, 1886. Handb. Zool., ed. 3, p. 46, fig. 39.
- LOBATULA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 145, 165–167.
- — *Sherborn and Chapman*, 1886. Journ. R. Micr. Soc., ser. 2, vol. vi, p. 756, pl. xvi, figs. 12 *a—c*.
- — *Malagoli*, 1887. Atti Soc. Nat. Modena: Rendiconti, ser. 3, vol. iii, p. 110, pl. i, fig. 14.
- — *Brady*, 1887. Journ. R. Micr. Soc., p. 920.
- — *Toutkowsky*, 1888. Zap. Kievskago, &c., vol. ix, p. 46, pl. vii, figs. 1 *a—c*.

- TRUNCATULINA LOBATULA, *B., P., and J.*, 1888. Trans. Zool. Soc., vol. xii, part 7, p. 227, pl. xlii, fig. 20; pl. xlv, figs. 26 *a—c*.
- — — *Steinmann*, 1888. Elemente Paläont., vol. i, p. 29, figs. 11 A, B, C.
- ROSALINA, sp., *Beissel*, 1891. Abhandl. k. Preuss. Geol. Landes., part 3, p. 74, pl. xiv, figs. 30—35.
- TRUNCATULINA LOBATULA, *Egger*, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, part 2, p. 396, pl. xvi, figs. 1—3, 10—12.
- — — *Fornasini*, 1893. Istit. Bologna, ser. 5, vol. iii, p. 435, pl. o, figs. 15, 15 *a*, 16, 16 *a*.
- — — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 444.
- PLANORBULINA LOBATULA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 88, pl. xv, fig. 774.
- TRUNCATULINA LOBATULA, *De Amicis*, 1895. Nat. Sicil. Ann., xiv, pp. 52 and 63.
- — — *Egger*, 1895. Jahresb., xvi, Nat. Ver. Passau, p. 31, pl. v, figs. 5 *a—c*.
- PLANORBULINA LOBATULA, *Goës*, 1896. Bull. Mus. C. Z, Harvard Coll., vol. xxix, p. 70.

*Characters*.—Shell suborbicular, plano-convex, consisting of from two to three convolutions, of which the outermost alone is visible on the convex surface. Each convolution composed of seven or eight segments. Convex surface depressed at the umbilicus. Segments ventricose on the upper, flat and truncate on the lower surface of the shell. Orifice single, large, at inner margin of the terminal chamber. Foramina conspicuous chiefly in young specimens.

*Occurrence*.—*Truncatulina lobatula* is found in all seas and at all depths down to 3000 fathoms. It is the most common of the Rotaline Foraminifera. Its geological range is also very great. Specimens have been obtained from rocks of Carboniferous age; and it is commonly met with in Mesozoic and later deposits. As a Tertiary fossil its range is similarly wide, and the amount of attention that has been bestowed upon it by naturalists may be seen from the table of synonyms given above.

In the Coralline Crag it is common in every zone we have examined; and it has also been found in the Upper Crag, as recorded in the First Part of the Monograph.

3. TRUNCATULINA VARIABILIS, *d'Orbigny*, 1826. Plate VI, fig. 23.

Testæ hammoniformes, *plano-cochleatæ, tuberosæ, articulatæ, &c., Soldani*, 1789.

Testaceographia, vol. i, pt. 1, pp. 77—80, pls. lxix and lxx (partly), lxxi—xcii, and xciii (partly).

TRUNCATULINA VARIABILIS, *d'Orbigny*, 1826. Ann. Sci. Nat., vol. vii, p. 279, No. 8.

— — — 1839. Foram. Canaries, part 2, p. 135, pl. ii, fig. 29.

— INNORMALIS, *Costa*, 1856. Atti Accad. Pont., vol. vii, p. 368, pl. xxi, figs. 11 A, B, C.

— EXCEDENS, *Costa*, 1856. Ibid., vol. vii, p. 250.

PLANORBULINA TRUNCATA, *Egger*, 1857. Neues Jahrb., &c., p. 280, pl. x, figs. 15—17.

TRUNCATULINA VARIABILIS, *Reuss*, 1864. Denksch. k. Akad. Wiss. Wien, vol. xxiii, p. 10, pl. i, fig. 15.

— — — *Mackie*, 1867. Sci. Gossip, p. 131, fig. 139.

PLANORBULINA VARIABILIS, *Reuss*, 1869. Sitz. k. Akad. Wiss. Wien, vol. lix, p. 460.

TRUNCATULINA VARIABILIS, *Reuss*, 1870. Ibid., vol. lxii, p. 490, No. 1.

NONIONINA, ANOMALINA, TRUNCATULINA, ROTALINA, *Schlicht*, 1870. Pietzpuhl, pp. 59, 60, 63, 64, pl. xxi, figs. 12—23, 27—29; pl. xxii, figs. 7—9, 20—23.

TRUNCATULINA TUBEROSA, *Parker, Jones, and Brady*, 1871. Ann. Mag. Nat. Hist., ser. 4, vol. viii, p. 177, pl. xii, fig. 138.

PLANORBULINA (TRUNCATULINA) VARIABILIS, *P. and J.*, 1872. Quart. Journ. Geol. Soc., vol. xxviii, p. 104.

TRUNCATULINA VARIABILIS, *Terquem*, 1876. Plage Dunkerque, fasc. 2, p. 75, pl. ix, figs. 3 a, b.

— TUBEROSA, *Brady*, 1877. Ann. Mag. N. H., ser. 4, vol. xix, p. 107.

— VARIABILIS, *Terquem*, 1878. Mém. Soc. Géol. France, sér. 3, vol. i, Mém. iii, p. 20, pl. i (vi), figs. 18—25.

— — — var. OBSCURA, *Terquem*, 1881. Plage Dunkerque, fasc. 3, p. 127, pl. xvi, figs. 7 a, b.

— — — *Terquem*, 1882. Mém. Soc. Géol. Fr., sér. 3, vol. ii, pt. ii, p. 92, pl. ix (xvii), figs. 22—25.

— — — var. of PLANORBULINA FARCTA, *Goës*, 1882. K. Sven. Vet.-Ak. Handl., vol. xix, No. 4, p. 96.

PLANORBULINA (TRUNCATULINA) VARIABILIS, *Brady*, 1882. Proc. R. Soc. Edinb., vol. xi, p. 712.

TRUNCATULINA VARIABILIS, *Brady*, 1884. Report 'Challenger,' p. 661, pl. xciii, figs. 6, 7.

— — — *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, pp. 189—191.



- TRUNCATULINA VARIABILIS, Woodward, 1885. Journ. N. York Micr. Soc., vol. i, p. 151.
- — Millett, 1886. Trans. Geol. Soc. Cornwall, vol. x, p. 226.
- — B., P., and J., 1888. Tr. Zool. Soc., vol. xii, pt. 7, p. 227, pl. xlv, fig. 17.
- — Terrigi, 1889. Mem. Acc. Lincei, ser. 4, vol. vi, p. 116, pl. vii, figs. 8, 9.
- — B., S., and B., 1890. Journ. R. Micr. Soc., p. 562, pl. xi, fig. 22.
- — Chapman, 1892. Quart. Journ. Geol. Soc., vol. xlviii, p. 517; and vol. l, 1894, p. 721.
- — Egger, 1893. Abhandl. k. Bayer. Ak. Wiss., vol. xviii, pt. 2, p. 404, pl. xvi, figs. 57—59, 63, 64.
- PLANORBULINA VARIABILIS, Goës, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 88.
- TRUNCATULINA LOBATULA, var. VARIABILIS, De Amicis, 1895. Nat. Sicil., Ann. xiv, p. 52.
- VARIABILIS, Fornasini, 1896. Rivista Italiana di Paleontologia, fasc. di Aprile, 1896, pp. 1—5, and fig. (= Costa's *Trunc. innormalis*).

*Character*.—In shell-structure similar to *Truncatulina lobatula*, but losing its relatively spiral arrangement in a wild-growing irregularity of the chambers in an apparently infinite variety of forms.

*Occurrence*.—This varietal form of *T. lobatula* has a geographical and bathymetrical range corresponding with the type. Its earliest recorded appearance as a fossil is from the Neocomian (Bargate beds of Surrey); it has also been found in the Gault, the Red Chalk, the Phosphatic Chalk of Taplow; the Miocene of Bavaria and Muddy Creek (Victoria), the Pliocene of Italy and St. Erth. In the Coralline Crag it is found somewhat rarely in every zone we have examined.

#### 4. TRUNCATULINA HAIDINGERI (*d'Orbigny*), 1846. Plate IV, fig. 18.

Part I, 1866, Appendices I and II, Tables, No. 80.

- (?) ROTALIA PROPINQUA (*von Münster*), Römer, 1838. Neues Jahrb. für Min., &c., p. 389, pl. iii, fig. 54.
- ROTALINA HAIDINGERI, *d'Orbigny*, 1846. For. Foss. Vien., p. 154, pl. viii, figs. 7—9.
- EHRENBURGII, Baily, 1851. Smithsonian Contrib., vol. ii, art. 3, p. 10, figs. 11—13.

- ROTALIA BRUECKNERI, *Reuss*, 1855. *Zeitschr. deutsch. geol. Gesellsch.*, vol. vii,  
 p. 273, pl. ix, fig. 7.  
 — PROPINQUA, *Reuss*, 1855. *Sitz. k. Akad. Wiss. Wien*, vol. xviii, p. 241,  
 pl. iv, fig. 53.  
 ROTALINA PROPINQUA, *Egger*, 1857. *Neues Jahrb. für Min., &c.*, p. 275, pl. vii,  
 figs. 14—17.  
 ROTALIA HAIDINGERI, *Jones and Parker*, 1860. *Quart. Journ. Geol. Soc.*, vol. xvi,  
 p. 302, No. 104.  
 ROTALINA HAIDINGERI, *Karrer*, 1861. *Sitz. k. Ak. Wiss. Wien*, vol. xlv, p. 455,  
 No. 124.  
 — — — 1864. *Ibid.*, vol. l, p. 719, No. 133.  
 ROTALIA SCUTELLARIS, *Karrer*, 1864. *Ibid.*, p. 709, pl. ii, fig. 13.  
 — PROPINQUA, *Reuss*, 1864. *Ibid.*, p. 475.  
 — PERFORATA, *Karrer*, 1864. *Novara-Exped.*, vol. i, Paläont. Abtheil., p. 81,  
 pl. xvi, fig. 13.  
 PLANORBULINA HAIDINGERI, *Jones and Parker*, 1864. *Geologist*, vol. vii, pp.  
 87, 89.  
 — — — *Brady*, 1864. *Trans. Linn. Soc.*, vol. xxiv, p. 469,  
 pl. xlviii, fig. 11.  
 — FARECTA, var. HAIDINGERII, *Parker and Jones*, 1865. *Phil. Trans.*,  
 vol. clv, p. 382, pl. xvi, figs. 22 a, b.  
 — HAIDINGERII, *P., J., and B.*, 1866. *Monogr. Foram. Crag*, App.  
 i and ii, No. 80, pl. iv, fig. 18.  
 TRUNCATULINA HAIDINGERI, *Reuss*, 1867. *Sitzungsb. Ak. Wiss. Wien*, vol. lv,  
 pp. 28, 100.  
 — — — *Karrer*, 1868. *Ibid.*, vol. lviii, p. 180.  
 PLANORBULINA HAIDINGERI, *Brady*, 1868. *Proc. Phil. Soc. Glasgow*, vol. vi,  
 p. 359.  
 TRUNCATULINA HAIDINGERI, *Fuchs and Karrer*, 1871. *Jahrb. k. k. geol. Reich-*  
*sanst.*, vol. xxi, p. 76.  
 PLANORBULINA HAIDINGERII, *Terrigi*, 1880. *Atti Accad. Pontif. N. Lincei*,  
 ann. xxxiii, p. 202, pl. ii, fig. 48.  
 TRUNCATULINA HAIDINGERII, *Brady*, 1884. *Report 'Challenger'*, pp. 127 and 663,  
 pl. xcv, figs. 7 a—c.  
 — — — 1887. *Journ. R. Micr. Soc.*, p. 921.  
 — HAIDINGERI, *Toutkowsky*, 1888. *Zap. Kievsk.*, vol. ix, p. 50, pl.  
 viii, figs. 3 a—c.  
 — — — *Egger*, 1893. *Abh. k. Bayer. Ak. Wiss.*, vol. xviii,  
 pt. 2, p. 401, pl. xvi, figs. 25—27.  
 — HAIDINGERII, *De Amicis*, 1893. *Boll. Soc. Geol. Ital.*, vol. xii,  
 p. 446.  
 — — — *Fornasini*, 1894. *For. Coll. Sold.*, *Sagg. Oritt.*,  
 p. 9.  
 — — — *De Amicis*, 1895. *Nat. Sicil.*, ann. xiv, pp. 53 and 63.  
 — (ROTALINA) HAIDINGERI, *Egger*, 1895. *Jahresb. xvi, Nat. Ver.*  
*Passau*, p. 29, pl. v, figs. 1 a—c.

*Characters.*—Shell orbicular, formed of from three to four revolutions of a spire, each consisting of six or seven chambers. Aboral surface more or less trochoid; the other (oral or inferior) face subconvex, often excavated at the umbilicus; formed of about six triangular chambers extending from the periphery to the umbilicus. Margin blunt, scarcely angular. Foramina numerous and conspicuous over every part of the shell.

Between the neat, well-defined, highly trochoid shell figured by d'Orbigny and the somewhat clumsy, indefinite examples of the same species found in the Crag there seem, at first sight, to be few characters in common; yet there need be no hesitation in regarding them as the same form. It is rare under any circumstances to meet with specimens so distinct in all external characters as the figures in the "Vienna Basin" monograph indicate; and, on the other hand, the few which have been found in the Crag (from Sutton and Sudbourne), though of average size, have their structure obscured either by the thickening of the shell wall from age, or by the mechanical effect of attrition.

*Occurrence.*—*Truncatulina Haidingeri* is not of frequent occurrence in the recent condition, though it has a wide range geographically. It has been found at various depths down to 1776 fathoms ('Challenger' Report) and 2140 fathoms ('Gazelle').

In the fossil condition it appears to be more common. Specimens have been found in the Neocomian (Bargate beds of Surrey); the Eocene (London Clay and Calcaire Grossier); the Miocene of Malaga, Italy, Vienna, and Muddy Creek (Victoria); and the Pliocene of Italy, Garrucha, and St. Erth. In the Coralline Crag we have found examples in nearly every zone examined.

### 5. TRUNCATULINA UNGERIANA (*d'Orbigny*), 1846. Plate II, figs. 11, 12.

Part I, 1866, Appendices I and II, Tables, No. 79.

*Ammonia univolutæ, Soldani*, 1780. Saggio Oritogr., p. 103, pl. iii, figs. 22, *h*, *H*, *I*.

*Hammonia Univolutæ, Soldani*, 1798. Testaceographia, vol. ii, App., p. 139, pl. iii, figs. 22 *h*, *H*, *I*.

ROTALIA (TURBINULINA) SIENNENSIS (?), *d'Orb.*, 1826. Ann. Sci. Nat., vol. vii, p. 275, No. 50.

ROTALINA UNGERIANA, *d'Orb.*, 1846. For. Foss. Vienn., p. 157, pl. viii, figs. 16—18.

— SEMIPUNCTATA, *Bailey*, 1851. Smithsonian Contrib., vol. ii, art. 3, p. 11, figs. 17—19.

— UNGERIANA, *Reuss*, 1851. Zeitsch. geol. deutsch. Ges., vol. iii, p. 76.

— — *Bornemann*, 1855. Ibid., vol. vii, p. 341, pl. xvi, fig. 5.



- ROTALINA ROEMERI, *Reuss*, 1855. Sitz. k. Ak. Wiss. Wien, vol. xviii, p. 240,  
 pl. iv, figs. 52 *a—c*.  
 ROTALIA UNGERIANA, *Jones and Parker*, 1860. Quart. Journ. Geol. Soc., vol. xvi,  
 p. 302, No. 105.  
 — INVOLUTA (var.), *Reuss*, 1861. Sitz. k. Akad. Wiss. Wien, vol. xlv,  
 p. 313, pl. ii, fig. 4.  
 — MORTONI, *Reuss*, 1861. Ibid., p. 337, pl. viii, fig. 1 (thick variety).  
 PLANORBULINA UNGERIANA, *Brady*, 1864. Trans. Linn. Soc., vol. xxiv, p. 469,  
 pl. xlviii, fig. 12.  
 — — *Jones and Parker*, 1864. Geologist, vol. vii, pp.  
 87, 89.  
 ROTALIA MACULATA, *Stache*, 1864. Novara-Exped., vol. i, Paläont. Abtheil., p. 278,  
 pl. xxiv, fig. 28.  
 ROSALINA THIARA, *Stache*, 1864. Ibid., p. 279, pl. xxiv, fig. 29.  
 — — var. ELATIOR, *Idem*, 1864. Ibid., fig. 30.  
 PLANORBULINA FARCTA, var. UNGERIANA, *P. and J.*, 1865. Phil. Trans., vol. clv,  
 p. 382, pl. xvi, figs. 23—25.  
 TRUNCATULINA UNGERANA, *Reuss*, 1866. Denkschr. k. Ak. Wiss. Wien, vol. xxv,  
 p. 161, No. 10.  
 PLANORBULINA UNGERIANA, *P., J., and B.*, 1866. Monogr. For. Crag, App. i and  
 ii, No. 79, pl. ii, figs. 11, 12.  
 — — *Brady*, 1868. Proc. Phil. Soc. Glasgow, vol. vi, p. 355.  
 — — *Anon.*, 1870. Sci. Gossip, p. 10, fig. 22.  
 TRUNCATULINA UNGERANA, *Reuss*, 1870. Sitz. k. Ak. Wiss. Wien, vol. lxii, p. 490,  
 No. 3; and *Schlicht*, 1870, Pietzpuhl,  
 pl. xxi, figs. 1—3.  
 PLANORBULINA UNGERIANA, *P., J., and B.*, 1871. Ann. Mag. N. H., ser. 4, vol.  
 viii, p. 174, No. 78, pl. xii, fig. 130.  
 PLANORBULINA UNGERIANA, *Morris*, 1876. Lect. Geol. Croydon, p. 8, fig. 2<sup>1</sup>.  
 — — *Terrigi*, 1880. Atti Acc. Pont. N. Lincei, vol. xxxiii,  
 p. 203, pl. iii, fig. 53.  
 TRUNCATULINA UNGERIANA, *Hantken* (1875), 1881. Mitth. Jahrb. Ung. Geol.  
 Anstalt, vol. iv, p. 72, pl. viii, figs. 7 *a, b*.  
 PLANORBULINA UNGERIANA, *Goës*, 1882. K. Sven. Vet.-Ak. Handl., vol. xix, No.  
 4, p. 100, pl. vii, figs. 234—236.  
 — — var. AFFIXA, *Goës*, 1882. Ibid., p. 103, pl. vii, figs.  
 237—241.  
 TRUNCATULINA UNGHERANA [UNGERIANA], *Hantken*, 1883. Ertekez., &c., vol.  
 xiii, No. 1, p. 12; 1884, Math. u.  
 Nat. Berichte Ungarn, vol. ii, p. 133.  
 — UNGERIANA, *Brady*, 1884. Report 'Challenger,' p. 664, pl. xciv,  
 figs. 9 *a—c*.  
 PLANORBULINA UNGERIANA, *Sherborn and Chapman*, 1886. Journ. Roy. Micr. Soc.,  
 ser. 2, vol. vi, p. 757, pl. xvi, figs. 16 *a—c*.  
 TRUNCATULINA UNGERIANA, *Fornasini*, 1886. Boll. Soc. Geol. Ital., vol. v, p. 144.  
 — — *Brady*, 1887. Journ. R. Micr. Soc., p. 921.  
 — — *A. Agassiz*, 1888. Voy. 'Blake,' vol. ii, p. 169,  
 fig. 518.

- TRUNCATULINA INVOLUTA, *Franzenau*, 1889. Math. u. Naturw. Berichten aus Ungarn, vol. vii, p. 263, pl. iv, fig. 4.
- ROTALIA, sp., *Beissel*, 1891. Abhandl. K. Preuss. Geol. Landes., n. s., part 3, p. 73, pl. xiv, figs. 20—24 (thick variety).
- TRUNCATULINA UNGERIANA, *Terrigi*, 1891. Mem. R. Com. Geol. Ital., vol. iv, p. 106, pl. iv, fig. 9.
- — — *De Amicis*, 1893. Boll. Soc. Geol. Ital., vol. xii, p. 447.
- — — *A. Silvestri*, 1893. Atti Rendic. Accad. Sci. Lett. Arti Zelanti Acireale, vol. v, p. 19, pl. iv, figs. 39—41.
- — — *Egger*, 1893. Abh. k. Bayer. Ak. Wiss., vol. xviii, part 2 (not descr.), pl. xvi, figs. 19—21.
- PLANORBULINA UNGERIANA, *Goës*, 1894. K. Svensk. Vet.-Akad. Handl., vol. xxv, No. 9, p. 90, pl. xv, fig. 780.
- TRUNCATULINA UNGERIANA, *De Amicis*, 1895. Nat. Sicil., Ann. xiv, pp. 53 and 63.
- PLANORBULINA UNGERIANA, *Goës*, 1896. Bull. Mus. C. Z., Harvard Coll., vol. xxix, p. 71.

*Characters*.—Shell free, orbicular, depressed; consisting of about three revolutions in a complanate spire; aboral side convex, depressed at the umbilicus; oral surface nearly flat; periphery thin, often acutely carinate. Chambers numerous (8—12), convex, extending to the umbilicus, and bounded by sinuous septal lines on the aboral side. Foramina generally very numerous and conspicuous; oral surface of the shell often granular.

The regular *Planorbulinæ* present so unbroken a series that it must always be a matter of individual judgment, rather than one of strict rule, how its subdivision should be effected. Hence, out of deference to the opinion of other authors, we have presented a somewhat limited synonym of *P. Ungeriana*, else we know of no permanent characters which would have precluded our adding *P. Akneriana* and many other so-called species to the list; for example, *Rotalina tuberculifera*, Reuss, *Rotalia granosa*, Reuss, *Truncatulina horrida*, Karrer, which differ from the normal form in their increased tendency to a granular or tubercular condition, especially of the lower surface.

*Occurrence*.—*Truncatulina Ungeriana* has a wide geographical and bathymetrical range. The 'Challenger' Report records its occurrence in the North and South Atlantic, the North and South Pacific, and the Mediterranean. We have numerous specimens in our own Collection from the Indian Ocean.

In a fossil condition it has been recorded from the Cretaceous of Swanscombe, Kent; the Eocene (London Clay); the Oligocene of Germany; the Miocene of Malaga, Italy, Vienna, and Muddy Creek (Victoria), and the Pliocene of Garrucha (Spain), Italy, and St. Erth. In the Coralline Crag we have it from every zone examined.







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A MONOGRAPH

OF THE

# BRITISH JURASSIC GASTEROPODA.

BY

WILFRID H. HUDLESTON, M.A., F.R.S., &c.,

VICE-PRESIDENT OF THE PALÆONTOGRAPHICAL SOCIETY.

PART I, No. 9.

GASTEROPODA OF THE INFERIOR OOLITE.

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## DIRECTIONS TO THE BINDER.

The Monograph of the British Inferior Oolite Gasteropoda will be found in the Volumes of the Palæontographical Society issued for the years 1886, 1887, 1888, 1889, 1891, 1892, 1894, 1895, and 1896. The General Title-page and Index of Species will be found in the Volume for 1896.

*Cancel* the Title-pages of Part I, No. 1, No. 2, No. 3, No. 4, No. 5, No. 6, No. 7, No. 8, and No. 9 in the Volumes for the years 1886, 1887, 1888, 1889, 1891, 1892, 1894, 1895, and 1896, and *substitute* the General Title-page in the Volume for the year 1896.

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391—444	XXXIII—XL	1895	October, 1895
445—514	XLI—XLIV	1896	October, 1896

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INFERIOR OOLITE GASTEROPODA.

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Genus—TROCHOTOMA, Deslongchamps, 1842.

“Shell trochiform, conical or depressed; base infundibuliform; whorls but slightly convex, keeled; sinus band obliterated up to the lip, with the exception of an oblong fissure, choked in the middle, bipartite; aperture subquadrangular, oblique; lip simple and without slit; columellar lip deeply sunk in the false umbilicus, entire, sinuous.”—FISCHER.

Specimens in our Inferior Oolite, which exhibit the more interesting characters of this genus, such as the strangulation of the fissure, and the sinuous or toothed character of the columellar lip, are exceedingly rare. This partly arises from the false umbilicus being plugged up with matrix. The toothed character of the columellar lip is well shown in a specimen of *Trochotoma Lindonensis*, from Lincoln (Pl. XLI, fig. 9). Fischer in 1885 constituted the section, *Didymodon*, on this feature, the type being *Trochotoma quinquecincta*, Zieten, from the Corallian of Nattheim, which in many respects resembles the Lincoln specimen.

The genus *Trochotoma* in this country is mainly confined to the Lower Oolites, being most abundant in the Bathonian section. The lowest horizons of our Inferior Oolite in Dorsetshire contain some forms which in Normandy are quoted from the Lias, such as *Trochotoma gradus*. We may admit that *T. gradus*, *T. affinis*, and *T. calix* are little more than varieties of one tabulate form.

386. TROCHOTOMA CALIX, Phillips, 1829. Plate XLI, figs. 1 *a*, 1 *b*, variety from the Cotteswolds, approaching *T. affinis*, Deslongchamps; figs. 6 *a*, 6 *b*, 6 *c*, typical form from the Dogger; fig. 7.

1829. SOLARIUM CALIX, Bean, MS. Phillips, Geol. Yorks., pt. 1, p. 157, pl. xi, fig. 30.

1854. TROCHOTOMA CALYX, Phillips. Morris, Cat., p. 280.

1875. — — — Geol. Yorks., pt. 1, 3rd edit., p. 259.

1885. — CALIX, Phillips. Hudleston, Geol. Mag., dec. 3, vol. ii, p. 156, pl. iv, figs. 6, 6 *a*, 6 *b*.

Non PLEUROTOMARIA CALIX, d'Orbigny. Terr. Jur., vol. ii, p. 476, pl. ccclxxxiii, figs. 6, 7.

*Bibliography, &c.*—On the view that we should separate *T. calix* from *T. gradus* and *T. affinis*, the synonymy given by me in the ‘Geol. Mag.’ is too comprehensive.

The type specimen of *Solarium calix* is not, I believe, to be found at York,



but Phillips' figure is characteristic. There are two varieties in the Dogger which we may refer to *T. calix*. Specimens are not uncommon, but the state of preservation is indifferent.

*Description* (more depressed variety) :

Height . . . . .	16 mm.
Basal diameter . . . . .	24 mm.
Spiral angle about . . . . .	90°.

Shell trochiform, tabulate, and profoundly excavated. Whorls (five) nearly rectangular, with a close suture. In some specimens the whorls of the spire show only one keel; but in others, where the spire is relatively higher, a lower keel is exposed. The upper keel is situate at the angle, and carries the obliterated fissure-band. Spiral ornament regular and in raised lines, which are somewhat wide apart (see fig. 7) and ropy, the sides of the whorls being somewhat concave.

The body-whorl exhibits a well-defined lower keel which is thick and subangular at the periphery; hence the body-whorl is strongly bicarinate and subconcave. The base is widely excavated. The aperture is depressed and oblique, but the available specimens from the Dogger do not admit of any close description. The loop is long and narrow, and its presence is often indicated on the upper keel by a raised border. In other specimens the loop, having been a source of weakness, causes a deflection in the continuity of the keel.

The variety from the Cotteswolds (figs. 1 *a*, 1 *b*), which presents features intermediate between *T. calix* and *T. affinis*, has a narrower spiral angle and a larger habit of growth. In some of these specimens it is possible to note the sinuous character of the columellar lip.

*Relations and Distribution.*—The features on which it is relied to separate *T. calix* from its undoubtedly close relatives, *T. gradus* and *T. affinis*, are possibly of little biological value. There really is very little difference except as to size, and, to some slight extent, in ornamentation. The truth is that all these tabulate Trochotomas are very much alike. Yet in the Dogger and partially also in the Cotteswolds certain small forms or races prevail which we know as *T. calix*; whilst in the Anglo-Norman area larger and more markedly tabulate forms, such as *T. gradus* and *T. affinis*, occupy the ground.

*T. calix* is fairly abundant in the *opalinus*-zone (Dogger) of Yorkshire, and a very similar form, with a very thick basal rim, occurs in the *opalinus*-zone of Frocester Hill. In the Oolite-Marl horizon (*Murchisonæ*-zone) we also get these small forms with the thick basal rim, as well as others of a larger size (figs. 1 *a*, 1 *b*) where this feature is not so conspicuous. In the base-bed at Lincoln (*Murchisonæ*-zone) are forms showing the connection between *T. calix* and *T. Lindouensis*.

387. *TROCHOTOMA GRADUS*, *Deslongchamps*, 1842. Inferior Oolite variety. Plate XLI, figs. 2 and 3.

1842. *TROCHOTOMA GRADUS*, *Deslongchamps*. Mém. Soc. Linn. Norm., vol. vii, p. 106, pl. viii, figs. 4—7.  
 1873. — — — — — Tawney, Dundry Gasteropoda (p. 53), 45.  
 Syn. *DITREMARIA BICARINATA*, *d'Orbigny*. Terr. Jur., vol. ii, p. 380, pl. ccexl, figs. 8—11.

*Bibliography, &c.*—The fossils described under the above title are not exactly the same as *T. gradus*, which in Normandy is regarded as a Liassic species. They are in fact intermediate between *T. gradus* and *T. affinis*.

*Description :*

Height . . . . .	28—30 mm.
Basal diameter . . . . .	40 mm.
Spiral angle . . . . .	95°.

Shell trochiform and broadly tabulate, with a somewhat obtuse apex; whorls of the spire almost rectangular and increasing by wide steps, being strongly angulated towards the middle. The ornaments consist of regular spiral lines, which pervade the entire shell and are somewhat wide apart; the lines are decussated obliquely. Sutures close.

The body-whorl is strongly bicarinate, the anterior carina forming a blunt angle at the periphery, whilst the space between the carinæ is considerably excavated. The base is infundibuliform and rounded towards the periphery, which is striated like the spire. Aperture for the most part concealed in all specimens available to me.

*Relations and Distribution.*—This is a tabulate form of *Trochotoma*. All my specimens are from Coker, occurring in beds which yield such an abundance of *Cirrus* (*Murchisonæ*-zone). Tawney mentions its occurrence at Dundry, but possibly this might be held to include *T. affinis*.

388. *TROCHOTOMA AFFINIS*, *Deslongchamps*, 1842. Plate XLI, fig. 4.

1842. *TROCHOTOMA AFFINIS*, *Deslongchamps*. Mém. Soc. Linn. Norm., vol. vii, p. 106, pl. viii, figs. 8—10.  
 Syn. *DITREMARIA AFFINIS*, *d'Orbigny*. Terr. Jur., vol. ii, p. 381, pl. ccexli, figs. 1—3.  
 — *TROCHOTOMA CARINATA*, *Lycett*. Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 417; and Cotteswold Hills, pl. iv, fig. 5.

*Description :*

Height	.	.	.	.	.	26 mm.
Basal diameter	.	.	.	.	.	32 mm.
Spiral angle	.	.	.	.	.	85°.

This is a less broadly tabulate form than the one previously described, the whorls being higher and the apex sharper. In some cases also the whorls are more numerous (six to seven). In other respects similar to *T. gradus*.

*Relations and Distribution.*—The figured specimen is from Stoford, and may be taken as the representative of *T. affinis*. Lycett figured his *T. carinata* with the fossils of the *Spinosa*-stage.

As before observed, we are almost entitled to look upon *T. calix*, *T. affinis*, and *T. gradus* as varieties of one species; where *T. gradus* is a large tabulate form with about six whorls and an obtuse apex, *T. affinis* is a large subtabulate form with higher whorls and a sharper apex; whilst *T. calix* is a small subtabulate form with five whorls and a very obtuse apex.

389. *TROCHOTOMA DEPRESSIUSCULA*, Lycett, 1850. Plate XLI, fig. 10.

1850.	<i>TROCHOTOMA DEPRESSIUSCULA</i> , Lycett.	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 417.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 78.
Cf. also	— DISCOIDEA, Römer.	Morris and Lycett, Grt. Ool. Moll., pt. i, p. 84, pl. x, fig. 10.

*Bibliography, &c.*—*T. depressiuscula* was not accepted by Morris in 1854, nor by Hudleston and Wilson in 1892. The type specimen is in the Jermyn Street Museum.

*Description :*

Height	.	.	.	.	.	13 mm.
Basal diameter	.	.	.	.	.	24 mm.
Spiral angle	.	.	.	.	.	100°.

“Depressed; whorls five, narrow and angulated; ribs below the angle three, above more numerous. Upper surface of the whorls concave, lower flattened; base striated, excavation large not deep, height half the basal diameter.”

*Relations and Distribution.*—More depressed even than *T. gradus*, and less strongly bicarinated. It is nearly related to “*T. discoidea*, Römer,” of the Great Oolite Mollusca, and may be the same as that form.



## 390. TROCHOTOMA LINDONENSIS, sp. nov. Plate XLI, figs. 8, 8 a, and 9.

But cf. TROCHUS QUINQUECINCTUS, Zieten. Verstein. Würt., p. 46, pl. xxxv, fig. 2 (*Trochotoma quinquecincta*, Zieten, Fischer, Man., p. 848).

Cf. also TROCHOTOMA CALIX, Phillips. Lycett, Cotteswold Hills, pl. iii, fig. 6 (fossils of the *Fimbria*-stage).

*Description :*

Height . . . . .	9 mm.
Basal diameter . . . . .	11 mm.
Spiral angle . . . . .	80°.

Shell thick, conical, subtabulate, and largely excavated. Spire rather obtuse at the apex, otherwise regular. Number of whorls five to six; these are angular with a narrow tabular ledge and steeply sloping flanks; sutures slightly canaliculate. The ornaments are sharp and conspicuous; the narrow posterior flat area of each whorl is marked by a strong granular spiral line between two deep sulci; the upper carina at the angle of the whorls is boldly prominent and somewhat subdivided, although there is no actual fissure-band; there is a single spiral rather below the middle of the side of the whorl (fig. 8 a), and this is followed by a sort of double basal keel, which causes the whorls of the spire, except at the extreme apex, to be bicarinate.

The body-whorl is strongly bicarinate with a very full and bluntly angular periphery, which is spirally striated up to the margin of the excavation. The loop is long and narrow. The aperture is subquadrangular, but curiously indented owing to the sinuous and toothed character of the columellar lip; the outer lip is thin at the margin, but toothed and grooved internally, in connection apparently with the loop.

*Relations and Distribution.*—The Lincoln shells are, in some cases, so well preserved as to exhibit characters which may exist in other British specimens of *Trochotoma*, but are yet obscured by the plugging of the basal cavity; hence a comparison with *T. calix*, for instance, is difficult. *T. Lindonensis* is related to *T. calix* just in the opposite direction to the latter's affinity for *T. gradus*. But it is distinguished from *T. calix* by its more conical outline, higher spire, and narrow tabulation; also by the invariable bicarination of the spire whorls, and the very considerable difference in the details of ornament. The specimen figured by Lycett as *T. calix* from the *Fimbria*-stage of the Cotteswolds possesses some of the features of *T. Lindonensis*, especially as regards ornament, and seems to be a kind of intermediate form.

On the other hand, *T. Lindonensis* presents a strong resemblance to *T. quinque-*



*cincta*, a Corallian species, and may possibly be identical. *T. Lindonensis* is rather abundant in the "base-bed" at Lincoln (*Murchisonæ*-zone), where it seems to replace *T. calix*. Specimens of *Trochotoma* from the Ironstone of Duston also possess considerable resemblance to the Lincoln shells.

391. *TROCHOTOMA FUNATA*, *Lycett*, 1850. Plate XLI, figs. 5 a, 5 b.

1850.	<i>TROCHOTOMA FUNATA</i> , <i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 417.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 78.
1854.	— — —	Morris, Cat., p. 280.

*Bibliography, &c.*—The acceptance by Morris of this species as an Inferior Oolite fossil is a strong point in its favour, but owing to the absence of any material evidence it was not listed by Hudleston and Wilson. Since that time a specimen answering fairly well to Lycett's diagnosis has been obtained from the Pea-grit of Nailsworth Hill. In some respects this specimen reminds me of *Pleurotomaria*.<sup>1</sup>

*Description :*

Height . . . . .	12 mm.
Basal diameter . . . . .	14 mm.
Spiral angle . . . . .	65°.

"Elevated, acuminate, nearly smooth; whorls convex, their lower portions flattened, with numerous encircling granulated ribs, faintly traced; basal excavation contracted. Height about equal to the basal diameter."

The aperture of the figured specimen has greatly the aspect of *Pleurotomaria*, but I cannot find any trace of the sinus-band.

FAMILY—FISSURELLIDÆ.

*Shell conical, limpet-shaped; apex recurved; nucleus spiral, often disappearing in the course of growth; anterior margin notched or shell perforated; muscular impression horseshoe-shaped, open in front.*

There are three genera of this family in the Inferior Oolite, *Rimula* being the most characteristically developed. In the case of *Emarginula* the anterior notch is not always in evidence. It is probable that the shells in the Jurassic Rocks

<sup>1</sup> Lycett also described "*Pleurotomaria funata*."

hitherto referred to *Fissurella* belong to another genus, possibly to *Puncturella*. I have never seen either in the Inferior Oolite or the Great Oolite a true keyhole Limpet.<sup>1</sup>

I have not seen any members of this family in the Dorset-Somerset district, nor in the Yorkshire Dogger. Inferior Oolite specimens are from the Cotteswolds and the Lincolnshire Limestone, but in all cases somewhat rare.

*Genus*—EMARGINULA, *Lamarck*, 1801.

*Shell oval, conical, elevated, with the apex recurved; surface cancellated; anterior margin notched; nucleus spiral; slit variable in extent.*

392. EMARGINULA SCALARIS, *Sowerby*, 1826. Plate XLI, figs. 12 *a*, 12 *b*. N.B.—In the figured specimen the intercostal lamellæ have perished.

1826.	EMARGINULA SCALARIS, <i>Sowerby</i> .	Min. Conch., pl. dxix, figs. 3 and ? 4.
1851.	— — —	Morris and Lycett, Gt. Ool. Moll., pt. i, p. 88, pl. viii, fig. 4.
1854.	— — —	Morris, Cat., p. 246, as from the Great Oolite and Inferior Oolite.
1885.	EMARGINULA SCALARIS, <i>Sowerby</i> .	Cossmann, Etage Bathonien, p. 346, pl. xii, figs. 39 and 40.
? Non	— — —	Deslongchamps, Mém. Soc. Linn. Norm., vol. vii, p. 125; and ? pl. vii, figs. 30—32.

*Bibliography, &c.*—The Ancliff fossils differ somewhat from those now figured; but the differences are probably due to mineralisation to some extent. Deslongchamps' identification is held by Cossmann to be incorrect, and he has named the species so identified *E. Deslongchampsii*.

*Description* (based on specimens from the Lincolnshire Limestone):

Length	} Approximate {	.	.	.	4 mm.
Width		.	.	.	2·75 mm.
Height		.	.	.	2·75 mm.

Shell elevated, apex posterior, periphery ovate, with slight expansion of the anterior area. The ribs, about seventeen in number, are nearly equal and

<sup>1</sup> Pl. viii, fig. 5, of Morris and Lycett's work must, I fear, be regarded as the result of artistic treatment.

prominent, but considerably narrower than the intercostal spaces. The latter are traversed by a system of cross-lines or lamellæ, giving the shell a scaly appearance (scarcely seen in the figured specimen). The two ribs which enclose the fissure approximate, but of the length of the fissure it is not easy to speak with certainty. The margin was probably crenulate.

*Relations and Distribution.*—This form, which most nearly approaches *E. scalaris* of the Great Oolite, is fairly abundant in what is believed to be the upper part of the Lincolnshire Limestone at Spittlegate Quarries. The species is quoted by Lycett from the Inferior Oolite of Leckhampton, but I have not seen any satisfactory specimens from that quarter.

393. *EMARGINULA LECKHAMPTONENSIS*, *Lycett*, 1850. Plate XLI, figs. 11 *a*, 11 *b*.

1850. *EMARGINULA LECKHAMPTONENSIS*, *Lycett*. Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 415.

1853. — — — Proc. Cotteswold Nat. Club, vol. i, p. 76.

*Description.*—"Oval, depressed; apex posterior; costæ large, rounded and tuberculated, where crossed by encircling lines; costæ twenty-six in number."

The figured specimen answers in many respects to Lycett's brief diagnosis, especially as to its oval shape and depressed character, but the costæ are no more than twenty in number. The following are the dimensions of the figured specimen, which is from Leckhampton.

Length	} Approximate	{	.	.	.	2.5 mm.
Width			.	.	.	2 mm.
Height			.	.	.	1.25 mm.

394. *EMARGINULA LINDONENSIS*, sp. nov. Plate XLI, figs. 14 *a*, 14 *b*; and ? 13 *a*, 13 *b*.

*Description:*

Length	.	.	.	.	.	4 mm.
Width	.	.	.	.	.	3 mm.
Height	.	.	.	.	.	2.75 mm.

Shell elevated, apex very posterior, periphery ovate and rather expanded anteriorly. Number of ribs twenty-five to twenty-six, prominent and wide. The intercostal spaces have closely-set lamellæ which infringe upon the costæ and produce a granular appearance; very fine intermediate costæ may also be noticed. There is but slight approximation of the pair of ribs which contain the fissure.



*Relations and Distribution.*—This is an elegant little shell belonging to the more highly ornamental species of *Emarginula*, represented in the Great Oolite by *E. Deslongchampsii*, Cossmann. The number of ribs and general ornamentation answer to *E. Leckhamptonensis*, Lycett. But this is an elevated species, whereas *E. Leckhamptonensis* is a depressed one. The “base-bed” at Lincoln has furnished the type, besides two smaller forms of similar shape but with fewer ribs.

The specimen (Figs. 13 *a*, 13 *b*) from the Lincolnshire Limestone of Stoke Lodge, with much the same dimensions and ornamentation, has a less oval periphery and only twenty ribs. In some respects this form seems intermediate between *E. scalaris* and *E. Lindonensis*.

395. *EMARGINULA GRANULATA*, *Lycett*, 1850. Not figured.

1850.	<i>EMARGINULA GRANULATA</i> ,	<i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 415.
1853.	—	—	—
1854.	—	—	—
			Proc. Cotteswold Nat. Club, vol. i, p. 76.
			Morris, Cat., p. 246.

*Bibliography, &c.*—There must have been something unusually satisfactory in this species to induce Morris, who ignored the majority of Lycett’s Inferior Oolite list, to give it a place in his catalogue. Hudleston and Wilson did not recognise it. Lately, however, the Brodie-Lycett collection has been acquired for the Jermyn Street Museum, and what purports to be a named specimen from the shelly freestones of Leckhampton is available for inspection.

*Description* —“Ovately globose; apex curved posteriorly; costæ numerous, very fine, with others still more delicate alternating, and rendered granular by transverse encircling lines.”<sup>1</sup>

*Genus*—*RIMULA*, *Defrance*, 1819 (? 1827).

*Shell having a general resemblance to Emarginula, but more capuliform, with a perforation on the midrib near the anterior margin, which is itself entire.*

Fischer, who regards this as a sub-genus, expresses a doubt whether the shells of the Mesozoic rocks, referred to *Rimula*, have precisely the same interior structure as those of more recent date.

<sup>1</sup> Lycett, ‘Ann. Mag. Nat. Hist.,’ 2nd ser., vol. vi, p. 410, also quotes *E. planicostula*, Deslong., from the I. O. of Leckhampton, and this is accepted by Morris.



396. *RIMULA CLATHRATA*, *Sowerby*, 1826. Plate XLI, figs. 15 *a*, 15 *b*.1826. *EMARGINULA CLATHRATA*, *Sowerby*. Min. Conch., pl. dxix, fig. 1.1851. *RIMULA CLATHRATA*, *Sowerby*. Morris and Lycett, Gt. Ool. Moll., pt. i, p. 86,  
pl. viii, fig. 1.

1854. — — — Morris, Cat., p. 276, from G. O. only.

1885. — — — Cossmann, Étage Bathonien, p. 342, pl. vi,  
figs. 31—33.

*Bibliography, &c.*—Essentially a Great Oolite species, the type being from Ancliff, rare at Minchinhampton; stated by Cossmann to be tolerably abundant at Epernay. Quoted by Lycett from the Inferior Oolite, Leckhampton. I have not seen satisfactory specimens myself from that locality. On the other hand, the Lincolnshire Limestone, which contains so many Bathonian forms, has yielded quite a series of fossils at Stoke Lodge, which may fairly be ranked under *R. clathrata*, though somewhat more angular in outline than the Ancliff shells.

*Description* (Inf. Ool. variety):

Length of base	} approximate	{	.	.	6 mm.
Width			.	.	4.5 mm.
Height			.	.	5 mm.

Shell capuliform with a perfectly oval base and curved apex, which projects considerably beyond the posterior margin. The convex dorsal area is somewhat flattened on each side of the very conspicuous midrib, which is separated from the ribs of either flank by a considerable space. From eight to ten strong longitudinal ribs on each side ornament the surface, and these are strongly decussated by transverse ribs producing nodes at the points of intersection: subsidiary longitudinal ribs may also be noted. The midrib is thick, and the lower edge of the perforation at a considerable distance from the anterior margin.

*Relations and Distribution.*—The size, the somewhat rounded back, and especially the regularly nodose ornamentation, may serve to distinguish this from any other species of *Rimula* in the Inferior Oolite. My specimens are all from Stoke Lodge.

397. *RIMULA RUGOSA*, sp. nov. Plate XLI, figs. 16 *a*, 16 *b*.

*Description*:

Length	} approximate	{	.	.	4 mm.
Width			.	.	2.5 mm.
Height			.	.	2.75 mm.

Shell small, conical, elevated; base oval, apex strongly curved posteriorly, sides compressed. The midrib and the two diverging lateral ribs on the anterior

area constitute a tricarinate figure, whilst smaller ribs to the number of about nine on each side occupy the flanks and posterior area. Extremely rich transverse ornament pervades the entire shell. The perforation (incorrectly shown in the apical figure) is at some distance from the anterior margin.

*Relations and Distribution.*—Differs from *R. tricarinata*, Sow., in being more elevated, in the less square outline of the anterior margin, and in the stronger character of the side ornaments. Two specimens from the "base-bed," Lincoln.

398. *RIMULA SUBTRICARINATA*, sp. nov. Plate XLI, figs. 17 *a*, 17 *b*.

*Description.*—This is an extremely small shell, so that even approximate measurements are difficult to obtain. Fairly elevated, with the apex curved so as to slightly overhang the posterior margin; with three conspicuous anterior ribs, of which the midrib is much the thickest, whilst the other two are thin and divergent; these constitute a tricarinate figure with a squarish anterior margin. The sides and posterior part of the shell are thickly costated, and the whole surface is marked with transverse lines, so as to produce a close and delicate reticulation throughout. The perforation is fairly distant from the anterior margin.

*Relations and Distribution.*—While evidently related, as regards its general figure, to *R. tricarinata*, Sow., the ornaments in this species are much closer and finer, also the two divergent anterior ribs are more slender. There are five specimens in my collection from the Pea-grit of Leckhampton.

399. *RIMULA ALTA*, *Lycett*, 1850. Plate XLI, figs. 18 *a*, 18 *b*.

1850. *EMARGINULA ALTA*, *Lycett*. *Ann. Mag. Nat. Hist.*, 2nd ser., vol. vi, p. 416.

1853. — — — *Proc. Cotteswold Nat. Soc.*, vol. i, p. 77.

*Bibliography, &c.*—Morris does not quote this species in his 'Catalogue' (1854), Fortunately there is one well-preserved specimen in the Jermyn Street Museum. which may be accepted as the type. This is evidently a *Rimula*, and is so marked in that collection.

*Description :*

Length of base	.	.	.	.	5·5 mm.
Width	.	.	.	.	3·75 mm.
Height	.	.	.	.	5 mm.

"Shell much elevated, compressed laterally; apex curved posteriorly, the convex side beneath the apex having narrow, simple, smooth, elevated ribs, of

which the middle one is the most prominent; there are also slight traces of smaller costæ upon the flattened sides of the shell; the height exceeds the length of the aperture; rare."

This diagnosis agrees with the specimen in the Jermyn Street Museum, although, according to my measurements, the height does not quite equal the length of the base.

*Relations and Distribution.*—The relative height and compression may serve to distinguish this from any other species of *Rimula*, though it is evidently related to the species erroneously identified by Morris and Lycett ('Great Oolite Moll.,' pt. i, p. 87, pl. viii, fig. 3), with *Rimula (Emarginula) Blotii*, Deslongchamps. The form figured by Morris and Lycett has been referred with a query to *R. Deslongchampsii*, Cossmann ('Ét. Bath.,' p. 342, pl. xii, figs. 33—34). *Rimula alta*, as a species, is based on a single good specimen from Leckhampton.

400. *RIMULA OOLITICA*, sp. nov. Not figured.

This name I propose for the forms in the Inferior Oolite which several British authors have referred, under the generic title of *Rimula*, to *Emarginula Blotii*, Deslongchamps.<sup>1</sup>

*Description.*—Shell small, strongly tricarinate, sides much compressed and flattened, and ornamented by seven or eight curved costæ of considerable prominence. The two intercarinal grooves are narrow, and show no trace of an intermediate rib. Transverse scalate ornament pervades the shell. Other indications clearly those of a *Rimula* and not of an *Emarginula*.

*Relations and Distribution.*—Differs from *R. tricarinata*, Sow., in its narrow, compressed, and elongated form: not so elevated as *R. alta*, which also possesses somewhat different lateral ornamentation; resembles the Great Oolite species

<sup>1</sup> Thus we find the following identifications:

1851.	<i>RIMULA</i>	<i>BLOTII</i> , <i>Deslongchamps</i> .	Morris and Lycett, Gt. Ool. Moll., pt. i, p. 87, where it is stated to occur in the shelly roestone at Leckhampton.
1854.	—	—	Morris, Cat., p. 275, both in G. O. and I. O.
1875.	—	<i>BLOTTII</i> (sic), <i>Deslongchamps</i> .	Judd, Geology of Rutland, p. 282, as a fossil of the Inf. Ool. in the Midlands (Etheridge).
1892.	—	<i>BLOTTII</i> , <i>Deslongchamps</i> .	Hudleston and Wilson, Cat., p. 116, both in G. O. and I. O. This view was based on the identifications of the authors previously quoted.



figured by Morris and Lycett (Great Oolite Moll., pt. i, p. 87, pl. viii, fig. 3), but is more compressed, more sharply angular, and quite devoid of the intermediate ribs in the intercarinal grooves.

There are three specimens from the Leckhampton freestones in the Brodie Collection.

*Genus*—PUNCTURELLA, *Lowe*, 1827.

*Shell conical, elevated, apex slightly recurved; perforation in front of the apex, small; interior exhibiting a raised border behind the aperture, and on a level with the apex; external surface cancellated.*

Mons. Cossmann was probably one of the first to point out that the Jurassic forms hitherto referred to *Fissurella* might with more justice be assigned to *Puncturella*. I have already stated that no true Keyhole Limpet has been seen by me from the Jurassic Rocks.

401. PUNCTURELLA ACUTA, *Deslongchamps*, 1842. A micromorph, Pl. XLI, figs 19 *a*, 19 *b*, 19 *c*.

- |       |   |  |
|-------|---|--|
| 1842. | FISSURELLA ACUTA, <i>Deslongchamps</i> .  | Mém. Soc. Linn. Norm., vol. vii, p. 122, pl. vii, figs. 22—24.       |
| 1851. | — — —                                     | Morris and Lycett, Great Ool. Moll., pt. i, p. 85, pl. viii, fig. 5. |
| 1885. | PUNCTURELLA ACUTA, <i>Deslongchamps</i> . | Cossmann, Étage Bathonien, p. 344, pl. vi, figs. 25—27.              |

*Description*.—The length of the figured specimen is about 2 mm., width and height a little less. The base is nearly circular, the apex subcentral. Radial costæ are numerous and close, and decussated by finer transverse lines, the points of intersection being marked by small rounded granulations. The perforation appears to be a little in front of the apex, and very narrow. The internal border or septum is distinctly visible in the figured specimen.

*Relations and Distribution*.—These micromorphs from the Peagrit of Leckhampton possess such a general resemblance to *Deslongchamps*' species that this identification seems legitimate. There are four specimens in my collection, all about the same size.



*Family*—CALYPTRÆIDÆ.

“Shell limpet-like, with the apex more or less spiral; interior simple or divided by a shelly process, variously shaped, to which the adductor muscles are attached.”—S. P. WOODWARD.

*Genus*—CAPULUS, Montfort, 1810.

“Shell conical, apex posterior, spirally recurved: aperture rounded; muscular impression horseshoe-shaped.”—S. P. WOODWARD.

Since *Capulus* dates from Palæozoic times, we need not be surprised at finding it in beds of Jurassic age. The two following species are somewhat more oval than is usual in this genus.

402. *CAPULUS RUGOSUS*, Sowerby, 1816. Plate XLII, figs. 1 *a*, 1 *b*, 2 *a*, 2 *b*.

1816. *PATELLA RUGOSA*, Sowerby. Min. Conch., pl. cxxxix, fig. 6.

1851. — — — Morris and Lycett, Gt. Ool. Moll., pt. 1, p. 89, pl. xii, figs. 1 *a*—1 *e* (non fig. 1 *f*).

1885. *PATELLA* (*HELCION*) *RUGOSA*, Sowerby. Cossmann, Étage Bathonien, p. 349, pl. xii, figs. 1—5.

1894. *CAPULUS RUGOSUS*, Sowerby. Böhm, Neues Jahrbuch, 1894, Bd. i, p. 201.

Syn. or var. *PATELLA TESSONII*, Deslongchamps. Mém. Soc. Linn. Norm., vol. vii, p. 113, pl. vii, figs. 3 and 4.

*Bibliography, &c.*—*Patella rugosa* was originally described by Sowerby from the Great Oolite of Minchinhampton, where it is extremely abundant, but for the most part much worn, like many of the Minchinhampton shells. Hence the slight spiral apex is in no case preserved in the Minchinhampton fossils. The species is very much rarer in the Inferior Oolite, yet specimens from the Lincolnshire Limestone, such as the one figured, do occasionally exhibit the capuliform apex. Such specimens had been in my Collection for some years, when Herr Böhm (op. cit.) was able to demonstrate that *P. rugosa* is in reality a species of *Capulus*.

*Description.*—The figured specimen has the following dimensions :

Length	.	.	.	.	.	44 mm.
Width	.	.	.	.	.	34 mm.
Height	.	.	.	.	.	12 mm.

Shell conical-depressed; base oval, but slightly expanding anteriorly; apex posterior with a slender spiral curve. The strong radiating ribs are closely arranged and decussated by encircling growth-lines, which are crowded on the posterior side, wide apart anteriorly. The actual apex is smooth, and presents an extremely small spiral knot, but the radiating ribs commence at a very early stage (figs. 2 *a*, 2 *b*).

*Relations and Distribution.*—Whether *Capulus* or *Patella*, this is by far the most abundant limpet-like shell in the Jurassic rocks. *P. Tessonii* may be regarded as a megalomorph from the “Oölithe ferrugineuse” of Moutiers, where the radial costæ are wide apart.

*Capulus rugosus* is certainly rare in the Inferior Oolite of this country. It is quoted from the “roestone” of Leckhampton Hill. I remember also to have seen a specimen of considerable size from an inland locality of the Yorkshire Dogger. Though by no means abundant, it is better represented in the Lincolnshire Limestone than in any other beds of Inferior Oolite age, *e. g.* Stoke Lodge, Ponton, and Weldon. Varieties of this species may also be noted in beds of later age than the Great Oolite.

403. CAPULUS ANCYLOIDES, *Sowerby*, 1824. Plate XLII, figs. 3 *a*, 3 *b*.

1824. PATELLA ANCYLOIDES, *Sowerby*. Min. Conch., pl. cdlxxxiv, fig. 2.

1851. — RUGOSA, *Sowerby*, pars. Morris and Lycett, Gt. Ool. Moll., pt. 1, p. 89, pl. xii, figs. 1 *f*, 1 *g*.

*Bibliography, &c.*—Originally described from Ancliff. *Sowerby* noted the decidedly spiral apex, “which being turned to one side makes it resemble the *Ancylus fluviatilis*.” Morris and Lycett regarded it as the immature form of “*Patella*” *rugosa*. There is only one specimen in the *Sowerby* type collection at the British Museum, somewhat cracked, but otherwise in good condition.

*Description:*

Length	.	.	.	.	.	6.5 mm.
Width	.	.	.	.	.	5 mm.
Height	.	.	.	.	.	2 mm.

Shell conical-depressed, smooth; base oval, apex spiral and posterior. The spiral coil is relatively large, and is marked by fine striæ (not sufficiently shown in fig. 3 *b*); the rest of the shell is devoid of all ornament, except concentric lines of growth, which become strong towards the margin.

*Relations and Distribution.*—The apical conditions of *Capulus* (*Patella*) *ancyloides* are so different from those of *Capulus rugosus*, that this alone would

justify their separation ; whilst in the shell itself the rugose radial ornamentation of the latter species is entirely wanting.

Rare in the Great Oolite of Ancliff and Minchinhampton. My own specimens are from the Lincolnshire Limestone (Inferior Oolite) at Stoke Lodge, whence several interesting fossils have been procured ; rare.

*Family*—PATELLIDÆ.

*Shell conical, with apex turned forwards ; muscular impression horseshoe-shaped, open in front.*—S. P. WOODWARD.

The Patellids of the Jurassic rocks have been described under several genera, viz. *Patella*, *Scurria*, *Acmaea*, *Scurriopsis*, *Guerangeria*, *Deslongchampsia*, &c. In the Inferior Oolite of this country we do not possess many more than half a dozen species, and these on the whole are scarce and locally distributed. In the absence of special evidence these will be described primarily under *Patella*.

*Genus*—PATELLA, *Linnæus*, 1758.

*Shell ovately conical, with an oblong or oval base ; apex subcentral, or inclining towards the anterior side ; internal surface smooth ; margin of the aperture entire.*

*Section A* without radial ornament (? = *Scurria*, Gray).

404. PATELLA INORNATA, *Lycett*, 1850. Plate XLII, figs. 4 a, 4 b.

1850.	PATELLA INORNATA,	<i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 415.
1853.	—	—	— Proc. Cotteswold Nat. Club, vol. i, p. 76.
? Syn.	—	—	<i>Morris and Lycett</i> . Gt. Ool. Moll., pt. 1, p. 93, pl. xii, figs. 11, 11 a.

*Description :*

Length	.	.	.	.	.	30 mm.
Width	.	.	.	.	.	18 mm.
Height	.	.	.	.	.	9 mm.

“Ovate, smooth ; apex pointed, moderately elevated, subcentral, but posterior and inclined slightly forwards.”

In specimens from the Great Oolite the figure is stated to be a more lengthened oval, whilst the apex is somewhat more elevated.

*Relations and Distribution.*—Less orbicular and less conical than *P. nitida*; moreover, in this species, the convex side (not sufficiently convex in fig. 4*a*) is the shorter. My best specimens are from the base of the Lower Freestones, Leckhampton, where *P. inornata* is not uncommon. It also occurs in the Northampton Sand at Duston, and in the Lincolnshire Limestone at Stoke Lodge.

405. PATELLA cf. CINGULATA, Münster, 1844. Plate XLII, figs. 5*a*, 5*b*, 5*c*.

1844. PATELLA CINGULATA, Münster. Goldfuss, Petref. Germ., pl. clxvii, fig. 11.

Morris and Lycett ('Great Ool. Moll.,' pt. i, p. 88) refer certain shells from the Cotteswolds to Münster's species. Their figures are not satisfactory; and, as *P. cingulata* is an Upper Jurassic form, Cossmann ('Étage Bathonien,' p. 354) suggests that the Great Oolite forms may represent a different species.

There are two specimens in the Jermyn Street Museum from the Inferior Oolite of Rollwright Heath, in Oxfordshire, which is very high in the series. In their depressed outline these specimens more nearly resemble the figures of Goldfuss than those of Morris and Lycett. The principal resemblance, however, is in the striated growth-lines (fig. 5*c*), thus producing a marked concentric ornamentation.

406. PATELLA NITIDA, Deslongchamps, 1842. Plate XLII, figs. 7*a*, 7*b*.

1842. PATELLA NITIDA, Deslongchamps. Mém. Soc. Linn. Norm., vol. vii, p. 116,  
pl. vii, figs. 7 and 8.

1850. — — — — — Lycett, Ann. Mag. Nat. Hist., 2nd ser.,  
vol. vi, p. 410.

*Bibliography, &c.*—There are two specimens in the Jermyn Street Museum, most probably from the Inferior Oolite, Leckhampton. On these Lycett based his identification.

*Description:*

Length	.	.	.	.	.	4.5 mm.
Width	.	.	.	.	.	4 mm.
Height	.	.	.	.	.	3 mm.

Shell conical, capuliform, with a high and sharp apex, which is subcentral.



The base is roundly oval, with a perfectly smooth edge. The surface is smooth, but with a strong lens it is possible to discern very faint concentric lines.

*Relations and Distribution.*—The points wherein *P. nitida* differs from *P. inornata* have been already indicated. *P. nitida* is stated by Deslongchamps to be common in the Bath Oolite of Normandy, whereas at Minchinhampton it seems to be represented only by *P. inornata*. *Scurria nitida* is quoted by Dr. Glangeaud ('Le Jurassique à l'ouest du plateau central,' p. 119) from beds of Bajocian age.

407. *PATELLA NANA*, *Sowerby*, 1824. Plate XLII, figs. 6 *a*, 6 *b*.

1824.	<i>PATELLA NANA</i> , <i>Sowerby</i> .	Min. Conch., pl. cdlxxxiv, fig. 3.
1851.	— — —	Morris and Lycett, Gt. Ool. Moll., pt. 1, p. 93, pl. xii, fig. 10.
1854.	— — —	Morris, Cat., p. 266 (G. O.).

*Bibliography, &c.*—Sowerby's enlargement of his *P. nana* from Ancliff represents a more oval shell than the one now figured. Morris and Lycett figure a more conical form with almost central apex, and this is the prevailing form at Minchinhampton and Bussage. It is just possible that Sowerby's species may be different.

*Description* (Lincolnshire Limestone specimen) :

Length	.	.	.	.	.	9 mm.
Width	.	.	.	.	.	8 mm.
Height	.	.	.	.	.	5.5 mm.

Shell small, suborbicular, conical; apex almost central, erect and subobtuse, smooth.

*Relations and Distribution.*—This small species has the most orbicular base of any of the smooth Patellas of the Inferior Oolite, and is correspondingly lofty. Specimens from the Lincolnshire Limestone are rather smaller and less peaked than some of those from the Great Oolite of Minchinhampton. Under certain conditions of preservation fine "cingulate" ornament may be detected, but the shell is always more peaked than Goldfuss' representations of *P. cingulata*.

Most of my specimens are from the Lincolnshire Limestone at Stoke Lodge. Not hitherto noticed in the Inferior Oolite of the Cotteswolds.

*Section B* with radial ornament.

408. *PATELLA RÖMERI*, *Morris and Lycett*, 1851. Plate XLII, figs. 8*a*, 8*b*.

1851. *PATELLA RÖMERI*, *Morris and Lycett*. Gt. Ool. Moll., pt. 1, p. 91, pl. xii,  
figs. 6, 6*a*, 6*b*.

A single specimen from the lowest bed of Tinkler's quarry at Stamford (Lincolnshire Limestone) greatly resembles the typical forms from Minchinhampton and Bussage. The Inferior Oolite specimen is somewhat more depressed and orbicular, whilst the interstitial radials are less conspicuous.

409. *PATELLA FENESTRÆ*, sp. nov. Plate XLII, figs. 9*a*, 9*b*.

*Description :*

Length	.	.	.	.	.	41 mm.
Width	.	.	.	.	.	31 mm.
Height	.	.	.	.	.	21 mm.

Shell elliptical, conical, elevated; apex nearly central, corroded and obtuse. Base oval, sides compressed. Ornamented by rugose radiating costæ, which are wide apart and decussated at wide intervals by concentric lines; tuberculations occur at the points of intersection. Margin thickened.

*Relations and Distribution.*—This form seems to stand alone amongst the Patellids of the Lower Oolites. The nearest described species of Jurassic age appears to be *P. sulcata*, Deslongchamps ('Mém. Soc. Linn. Norm.,' vol. vii, p. 115, pl. vii, figs. 9 and 10), from the Inferior Oolite of Port-en-Bessin. But even this species differs widely. On the other hand, its resemblance to the more elevated varieties of the existing *Patella vulgata* are quite startling.

A single specimen has been found by Mr. Windoes in the Chipping Norton Limestone, which overlies the *Clypeus*-grit in the neighbourhood of that town. This may be regarded as the highest horizon of the Inferior Oolite.

410. *PATELLA RETIFERA*, *Lycett*, 1850. Not figured.

1850. *PATELLA RETIFERA*, *Lycett*. Ann. Mag. Nat. Hist., 2nd ser., vol. vi,  
p. 415.

1853. — — — Proc. Cotteswold Nat. Club, vol. i, p. 76.

Syn. *FISSURELLA BRODIEI*, *Lycett*. Ann. Mag. Nat. Hist., vol. cit., p. 415;  
and Proc. Cotteswold Nat. Club, vol. cit.,  
p. 76.

*Bibliography, &c.*—Briefly described by Lycett, but not figured. Not accepted by Morris, nor enumerated by Lycett in the ‘Cotteswold Hills’ amongst the fossils of the *Fimbria*-stage. In the absence of further evidence *P. retifera* was included by Hudleston and Wilson in the list of “species not accepted.” Quite lately (1895) Mr. Brodie’s collection of fossils from the Leckhampton freestones has been acquired for the Jermyn Street Museum. There are two specimens purporting to be *Patella retifera*, besides specimens of *Fissurella Brodiei*, which latter is a closely allied, if not identical form, in a somewhat different matrix. The labels are not in Lycett’s handwriting.

*Description :*

Length	.	.	.	.	.	9 mm.
Width	.	.	.	.	.	6.5 mm.
Height	.	.	.	.	.	4 mm.

“Ovate, costated, and cancellated; costæ numerous and unequal, crossed by numerous encircling lines; apex moderately elevated, posterior, but inclined forwards.”

The so-called *Fissurella Brodiei* exhibits the same characters, but is a slightly narrower shell.

*Relations and Distribution.*—Both radial and concentric ornaments of this extremely pretty little shell are very sharp, and this serves to distinguish it from *Patella* (*Guerangeria*) *clypeola*, Deslongchamps, a Bathonian species, where the radial ornamentation only is in evidence. There is something peculiar in the character of the apex, which seems to indicate that it may not be a *Patella* in a strict sense, though none of the specimens could be placed under *Fissurella*.

There are about half a dozen specimens in the Brodie Collection from the Leckhampton freestones, which contain a shallow-water fauna.

ORDER—OPISTHOBRANCHIATA, *Milne-Edwards*.SUB-ORDER—TECTIBRANCHIATA, *Cuvier*.

N.B.—The fossil Opisthobranchiata have lately received a large share of attention in M. Cossmann's admirable work 'Essais de Paléoconchologie comparée' (Première livraison, Février, 1895); and still more recently in his splendid Monograph, 'Études sur les Gastropodes des Terrains Jurassiques,' now in course of publication in the Memoirs of the Geological Society of France. This author greatly favours the subdivision of families and genera. Thus we find the following families enumerated from the Jurassic rocks,—Actæonidæ, Tornatinidæ, Bullidæ, Aceridæ (nov. fam.), and Aplustridæ. M. Cossmann also includes *Ceritella* and *Fibula* amongst the Opisthobranchiata under Tubiferidæ (nov. fam.). The genera and sections are also largely multiplied. Without in the slightest degree questioning the scientific value of these subdivisions, it is proposed to group the Opisthobranchiata of our Inferior Oolite, for present purposes, under the families Tornatellidæ (Actæonidæ) and Bullidæ.

## Family—TORNATELLIDÆ (ACTÆONIDÆ).

"Shell external, convoluted, ovoid, conoidal, spire depressed or prominent; whorls tolerably numerous, without internal absorption, aperture entire, narrow."—FISCHER.

N.B.—The following genera, subgenera, and sections of this family are recognised by M. Cossmann as occurring in the Inferior Oolite, viz. *Tornatellæa*, Conrad (e.g. *T. pulchella*, Deslong.); *Actæonina*, d'Orbigny (e.g. *A. gigantea*, Deslong.); *Striactæonina*, nov. sect. (e.g. *Act. Sarthacensis*, d'Orb.). *Cylindrobullina*, von Ammon (e.g. *Act. Scarboroughensis*, Lycett; *Cylindrites*, Morris and Lycett (e.g. *Actæon acutus*, Sowerby).

*Trochactæonina*, Meek, is also quoted from the Bathonian (e.g. *Act. ventricosa*, d'Orbigny, and *Cassis Esparcyensis*, d'Archiac).

In the present instance it is proposed to retain the older generic classification of the Tornatellidæ of the Inferior Oolite, whilst indicating as far as possible the equivalents under the new system. For the most part the specimens are not sufficiently well-preserved to show the finer points.



Genus—*ACTÆON*, Montfort, 1810.

“Shell oval, spirally striated; spire prominent, conical, sharp; apex reversed; suture well-marked; aperture lengthened, entire, rounded at the base; outer lip sharp, columella furnished with a strong basal fold.”—FISCHER.

In *Tornatellæa*, Conrad, there are two folds, and the aperture is slightly notched at the base.

411. *ACTÆON* (*TORNATELLÆA*) *PULCHELLUS*, Deslongchamps, 1848. Plate XLII, figs. 12 and 13.

1848. *TORNATELLA PULCHELLA*, Deslongchamps. Mém. Soc. Linn. Norm., vol. viii, p. 162, pl. xviii, fig. 4.

185? *ACTÆONINA PULCHELLA*, d'Orbigny. Terr. Jur., vol. ii, p. 169, pl. cclxxxvi, figs. 7 and 8.

1895. *TORNATELLÆA PULCHELLA*, Deslongchamps. Cossmann, Gastr. Terr. Jur., p. 14, pl. i, figs. 6—8.

*Bibliography, &c.*—Deslongchamps described this species as having three columellar folds, though it might require an exceptionally well-preserved specimen to show them. He justly hesitated to make a new genus. D'Orbigny placed it with doubt under *Actæonina*, considering that the folds indicated by Deslongchamps might bring it within the range of *Actæon*. The species is not quoted as British either by Morris or by Hudleston and Wilson.

*Description:*

Height	.	.	.	.	.	11 mm.
<sup>1</sup> Body-whorl to total height	.	.	.	.	.	60 : 100.
Spiral angle.	.	.	.	.	.	55°.

Shell oval, apex acute; whorls from five to six, tumid, with tabulated edge, body-whorl large. The entire shell is marked with deeply cut striæ, wide apart, and exhibiting punctations. Aperture sub-elongate, elliptical, columella short and marked with oblique folds two or three in number; indications of an anterior notch.

*Relations and Distribution.*—This is perhaps one of the best marked species belonging to the *Tornatellidæ* which the Inferior Oolite affords. Undoubtedly it belongs to *Actæon* rather than to *Actæonina*, and to the section or sub-genus

<sup>1</sup> Measured at the back of the shell.

*Tornatellæa*, Conrad. There are three specimens in my Collection from the *Parkinsoni*-zone of Burton Bradstock, one from the same horizon at Grove, and two smaller specimens from the *Parkinsoni* Marl of Bradford Abbas.

412. ACTÆON (TORNATELLÆA) OOLITICUS, sp. nov. Plate XLII, fig. 11.

*Description:*

Height . . . . .	13 mm.
Body-whorl to total height . . . . .	55 : 100.
Spiral angle . . . . .	48°.

Shell oval, apex acute. Number of whorls six, sub-tumid, with the posterior edge more sloping than tabulate. The spiral striæ are close, deeply cut and punctate, the sloping shoulder of the whorls exhibiting a special form of grooving, whilst the spirals in the upper portion of the whorls are wider apart. Aperture sub-elongate, elliptical, with a very short columella; this has evidently been marked with oblique folds, but it is not easy to say whether two or three; indications of an anterior notch.

*Relations and Distribution.*—This form obviously differs from *Actæon pulchellus* in its more slender shape, in the comparatively sloping posterior margin of the whorls, and especially in the general closeness of the spiral striæ. It is near to *Tornatellæa multistriata*, Rigaux and Sauvage, and also resembles *Tornatellæa Brasili*, Cossmann, which is described from the Bajocian of France.

The finest specimens of *Actæon ooliticus* occur in the *Concavus*-bed at Bradford Abbas. Stoford and Horton Hill have also yielded specimens, which bear considerable resemblance to the Bradford Abbas forms. When the folds on the aperture have been effaced, it might be difficult to distinguish this species from *Actæonina pulla*, K. and D. There is a very slender variety with five whorls from the "Base-bed," Lincoln, ? a distinct species.

413. ACTÆON SCULPTUS, *Lycett*, 1850. Plate XLII, figs. 10 and 10 a.

1850.	CERITELLA SCULPTA, <i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 419.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 80.

The following is *Lycett's* diagnosis :—"Small, turritid; whorls few, long, nearly flat, each with three encircling striæ, equidistant; the body-whorl has six striæ besides numerous others closely arranged at the base."

The figured specimen has the following dimensions:—Height 10 mm., spiral angle  $45^{\circ}$ . The number of whorls five; aperture sub-elongate, elliptical, with a short columella, which has folds and anterior notch somewhat reflexed.

*Relations and Distribution.*—Lycett's type is smaller than the figured specimen, and ill-preserved, but there is sufficient of the aperture remaining to show that it belongs to this section of *Actæon* (*Tornatellæa*): it was obtained from the Free-stones of the Cotteswolds—*Murchisonæ*-zone. The figured specimen is a larger shell, and was obtained from Drympton (most probably *Opalinus*-zone).

This species comes very near to *Tornatellæa inæquistriata*, Cossmann, from the *Murchisonæ*-zone of the Meurthe.

Besides the three species of *Actæon* (*Tornatellæa*) described above, there are two other species or varieties: viz. a form in the *Opalinus*-bed, Drympton, resembling but not identical with *Actæon pulchellus*; secondly the narrow form from the "Base-bed," Lincoln, provisionally classed with *Actæon ooliticus*.

*Genus*—*ACTÆONINA*, d'Orbigny, 1850 (= *Orthostoma*, Deshayes).

"Shell oval or fusiform; spire salient, but shorter than the last whorl, which is angular in the vicinity of the suture; aperture elongated, narrow, entire, not sinuous; outer lip simple, sharp; columellar lip curved; columella thick, but smooth."—FISCHER.

There is nothing in this diagnosis with reference to sculpture, but one might add "smooth or striated." The above is a somewhat generalised diagnosis, which would include the sections previously mentioned.

The genus *Actæonina* is interesting to the palæontologist as perhaps the oldest member of the Tornatellidæ, the section, *Cylindrobullina*, dating back from Carboniferous times. It is best represented in the Jurassic period, and, according to d'Orbigny, the maximum development of the genus was attained during the deposition of the Lower Lias. As regards distribution in the Inferior Oolite of this country, the several horizons in Yorkshire have yielded a considerable number of species, the Lincolnshire Limestone and the Inferior Oolite of the Cotteswolds are also accountable for several species, whilst the Dorsetshire beds, usually so rich in Gasteropods, have not yielded many species of *Actæonina*.

We may admit that *Actæonina* is an inconveniently large genus, including forms of somewhat diverse character, both as to shape and ornamentation. As regards ornamentation merely, we might divide the *Actæoninas* of the Inferior Oolite into three groups:

1. *Actæoninæ* with deep spiral grooving and a general resemblance to *Actæon*



(*Tornatellæa*), but with no proved columellar plication. This group includes such forms as *Auricula Sedgwicki* and *Tornatella pulla*, which I have hitherto classed with the Actæons, as indeed have most authors, though Tate referred *Tornatella pulla*, K. and D., to *Actæonina*.

2. *Actæoninæ* with fine spiral lines (*Striactæonina* in part) such as *Actæonina Sarthacensis*, d'Orbigny. Possibly also *Actæonina humeralis*, Phillips, which has a strongly impressed line on the shoulder, might come in here.<sup>1</sup>

3. *Actæoninæ* which are perfectly glabrous, or only exhibit striation, more or less faint, towards the anterior extremity. This division would include, amongst others, *Actæonina* as limited, and the sections *Ovactæonina*, *Cylindrobullina*, and *Trochactæonina*.

414. ACTÆON vel ACTÆONINA SEDGVICI, *Phillips*, 1829. Plate XLII, fig. 15.

- |          |          |           |                   |  |
|----------|----------|-----------|-------------------|--|
| 1829-35. | AURICULA | SEDGVICI, | <i>Phillips.</i>  | Geol. Yorks, part 1, pl. xi, fig. 33.                                  |
| 1850.    | ACTÆON   | SEDGVICI, | <i>d'Orbigny.</i> | Prod., i, p. 263.  |
| 1851.    | —        | —         | <i>Phillips.</i>  | Morris and Lycett, Grt. Ool. Moll., part i,<br>p. 118, pl. xv, fig. 9. |
| 1885.    | —        | —         | —                 | Hudleston, Geol. Mag., 1885, p. 252, pl. v,<br>fig. 4.                 |

*Bibliography, &c.*—Owing to imperfect preservation it is still doubtful whether Phillips' species is an *Actæon* or a striated *Actæonina*. "In the few cases where the aperture has been visible it is invariably without plication" (Hudleston, *loc. cit.*). Brauns ('Mittlere Jura,' p. 194) considered *Tornatella pulla*, K. and D., the same as *Actæon pullus*, Morris and Lycett, but different to *Auricula Sedgwicki*, Phillips.

*Description*.—From 5 to 10 mm. in height and considerably more than half as wide as high. Ovate, with a stumpy spire composed of about three whorls. The whorls are strongly tabulate. The body-whorl and penult are ornamented by deeply-cut spiral striæ, which are but slightly punctate; the surface of the body-whorl is thus divided into a number of strap-like belts, of which two, situated slightly below the middle, are wider than the rest. Other indications wanting.

*Relations and Distribution.*—A stumpy form almost peculiar to the Dogger,

<sup>1</sup> Stoliczka remarked that the "surface of many *Actæoninæ* appears to be perfectly smooth, but it is more likely this is only in consequence of the uppermost punctated layer of the shell having been removed" ('Cretaceous Gastropoda of Southern India,' p. 399).



where it takes the place of *Actæonina pulla*. Indifferent specimens, smaller than the one figured, are not rare. I have one specimen from the Pea-grit of Leckhampton.

415. *ACTÆONINA PULLA*, *Koch and Dunker*, 1837. Plate XLII, fig. 14.

1837. *TORNATELLA PULLA*, *Koch and Dunker*. Beiträge Nordd. Oolith., p. 33, pl. ii, fig. 11.  
 1851. *ACTÆON PULLUS*, ? *Koch*. Morris and Lycett, Grt. Ool. Moll., part 1, p. 119, pl. xv, fig. 11.  
 1876. *ACTÆONINA PULLA*, *Koch and Dunker*. Tate and Blake, Yorkshire Lias, p. 356.  
 1885. *ACTÆON SEDGVICI*, *Phil.*, var. *PULLA*, *Morris and Lycett*. Hudleston, Geol. Mag., 1885, p. 253, pl. v, fig. 5.

*Description*.—Morris and Lycett say :—"Shell ovate, spire elevated, somewhat acute; whorls (six) convex, the last whorl sub-cylindrical; aperture ovate; the surface with numerous regular punctated encircling striæ." The above description refers to specimens either from the Millepore-bed or the Scarborough Limestone.

*Relations and Distribution*.—More elongated and oval than *Actæonina Sedgvici*, and probably a more widely distributed form. I have specimens from the Scarborough Limestone of Scarborough Bay which are rather stouter than Morris and Lycett's type. *Actæonina (Actæon) pulla* also occurs in the Lincolnshire Limestone at Weldon, and in the Inferior Oolite of Hook Norton (Walford Collection). These are all specimens without folds on the columella. But it is quite possible that, in some instances, imperfectly preserved specimens of *Actæon (Tornatellæa)*, such as *Actæon ooliticus*, are set down to Koch and Dunker's species. In this way *Actæonina (Actæon) pulla* is a convenient name for any small and badly preserved specimen of the striated Tornatellidæ.

416. *ACTÆONINA "PULLOIDES."* Plate XLII, fig. 16 and 16 a.

*Description*.—This is a small form, from 5 to 6 mm. in height and with a spiral angle of about 58°; oval-oblong, number of whorls five, tumid with a slight ledge on the posterior margin, which is marked by an impressed line. Body-whorl about twice the height of the spire. The texture of the shell is smooth with very fine striations, which have a tendency to become effete towards the centre of the body-

whorl (fig. 16 *a*), but are well marked where the anterior compression commences. Aperture ovate-elongate with a thin straight outer lip and a smooth columella.

*Relations and Distribution.*—Differs from *Actæonina pulla* in the fineness of the striations, though, if we accept the view of Stoliczka, this may be somewhat a matter of preservation. Resembles *Actæonina sparsisulcata*, d'Orbigny ('Terr. Jur.,' ii, p. 166, pl. 285, figs. 14 and 15). This form occurs in the Lincolnshire Limestone at Weldon, in the *Parkinsoni*-zone of Burton Bradstock, and in the *Cadomensis*-bed at Osborne.

Since I do not venture to constitute this as a distinct species, it may be regarded as a possible variety of *Actæonina pulla*.

417. ACTÆONINA (STRIACTÆONINA) TENUISTRIATA, sp. nov. Plate XLII, figs. 18, 19,  
19 *a*.

1885. ACTÆONINA HUMERALIS, *Phillips*, striated variety. Hudleston, Geol. Mag.,  
1885, p. 202, pl. v,  
fig. 3.

Cf. also ACTÆONINA SARTHACENSIS, *d'Orbigny*. Terr. Jur., vol. ii, p. 167, pl. cclxxxvi,  
figs. 1 and 2.

*Description :*

Height	.	.	.	.	.	12 mm.
Body whorl to total height	.	.	.	.	.	75 : 100.
Spiral angle	.	.	.	.	.	60°.

Shell cylindro-conical; the spire occupies about one fourth of the total height, and consists of five or six whorls, which are cylindrical with tabulate posterior margin, except towards the very sharp apex, where they are slightly convex. The entire shell is pervaded by fine and close striato-punctate ornament. There is a strongly impressed line on the posterior margin of the whorls, and a somewhat finer line on the flat area between the margin and the suture. The body-whorl is a narrow cylinder much compressed anteriorly; aperture ovate-elongate with a smooth columella.

*Relations and Distribution.*—This may be regarded as a narrow representative of *Actæonina Sarthacensis* on a lower horizon. (Cossmann says that *A. Sarthacensis* is really a Bathonian species, and not Bajocian as represented by d'Orbigny.) On the other hand, if we accept the suggestion of Stoliczka as regards striation in the Tornatellidæ, *Actæonina tenuistriata* may be nothing more than a different mineral condition of *Actæonina humeralis*. This was the view I took in 1885. There are, however, certain slight differences of shape which favour the notion of their being distinct species.

Occurs sparingly in the Yorkshire Dogger. I have also a specimen from Dorset (? Broad Windsor), which might be thus referred.

418. *ACTÆONINA* (? *STRIACTÆONINA*) *HUMERALIS*, *Phillips*, 1829. Plate XLII, figs. 20 *a*, 20 *b*.

1829-35. *ACTÆON HUMERALIS*, *Phillips*. Geol. Yorks., part 1, pl. xi, fig. 34.

1850. *ACTÆONINA HUMERALIS*, *d'Orbigny*. Prod., i, p. 264.

1885. — — *Phillips*. Hudleston, Geol. Mag., 1885, p. 202, pl. v, figs. 1, 1 *a*.

*Description* (based principally on the type-specimen, which is somewhat affected by mineralisation) :

Height . . . . .	15 mm.
Body-whorl to total height . . . . .	71 : 100.
Spiral angle . . . . .	66°.

Shell cylindro-conical; the spire about three-tenths the total height, and composed of five whorls. In many respects the description of the preceding species is applicable to this one. Thus the whorls of the spire are flat atop and marked on the shoulder by a grooved line, which produces two steps, or a sort of double tabulation. The grooving on the shoulder is very distinct in the body-whorl, which is perfectly cylindrical. But there are no traces of spiral striation, except some faint lines towards the anterior extremity. The length of the aperture is about two-thirds the height of the shell: it is narrow behind, wide in front; outer lip straight and thin, columellar lip smooth and without plications.

*Relations and Distribution.*—*Actæonina humeralis* is not uncommon in the Yorkshire Dogger, though good examples are scarce. Many specimens also are much smaller than the one figured.

A narrow and perfectly glabrous variety occurs in the *Concavus*-bed at Bradford Abbas. My "MS." name for this variety is "*sub-humeralis*." This passes by degrees into a distinct form.

419. *ACTÆONINA SUBOVALIS*, sp. nov. Plate XLII, fig. 21.

*Description* :

Height . . . . .	16 mm.
Body-whorl to total height . . . . .	65 : 100.
Spiral angle . . . . .	50°.



Shell oval-elongate. Total number of whorls six, the spire occupying from three to four tenths of the entire height. The apex is slightly obtuse. The whorls are subconvex, with a narrow posterior ledge indented by a deep groove; sutural angle oblique. The body-whorl is very ovate, and like the rest of the shell perfectly smooth, growth-lines alone being visible. The aperture is oval-elongate, and about half the height of the entire shell. There is a considerable incrustation on the columella, which is only slightly sinuous.

*Relations and Distribution.*—The peculiar ovate-elongate character of this shell and the convexity of the whorls forcibly remind us of *Actæonina Loricæana*, d'Orb., which may be regarded as a typical *Ovactæonina*. On the other hand, the grooved ledge on the posterior margin of the whorls, although very narrow, serves to remind us of *Striactæonina*.

A single specimen from the *Concavus*-bed, Bradford Abbas.

420. ACTÆONINA (CYLINDROBULLINA) GLABRA, *Phillips*, 1829. Plate XLII, figs. 22, 23 *a*, 23 *b*.

1829-35. ACTÆON GLABER (Bean, MS.), *Phillips*. Geol. Yorks., part 1, pl. ix, fig. 31.

1851. ACTÆONINA GLABRA, *Phillips*. Morris and Lycett, Grt. Ool. Moll., part 1, p. 120, pl. xv, fig. 10.

1885 ? — — — — — Hudleston, Geol. Mag., 1885, p. 205, pl. v, figs. 6 and 6 *a*.

*Bibliography, &c.*—The type of *Actæon glaber* is probably lost, but figs. 23 *a*, 23 *b* represent a specimen in the Bean Collection (that portion now in the British Museum), which is thus labelled. Although a typical form, it is somewhat larger than usual, and the drawing suggests *Cylindriles*, for which there is probably no justification. Fig. 22 represents a medium-sized shell.

*Description :*

Height . . . . .	10—20 mm.
Body-whorl to total height . . . . .	90 : 100.
Spiral angle . . . . .	80°.

Shell cylindro-conical, with a very short spire. The whorls of the spire (four) are sub-tumid and sloping with a posterior ledge or tabulation which is rounded off at the margin. The body-whorl is elongate and quite cylindrical, and like the rest of the shell smooth, even the growth lines being very fine, and in many specimens scarcely visible.

The aperture is extremely long and narrow in the upper half, but widens anteriorly owing to the hollowing out of the columellar region; the columellar



lip is thickened and drawn out obliquely, being quite smooth and rounded at the extremity.

*Relations and Distribution.*—*Actæonina glabra* possesses the most stumpy spire of all the truly cylindro-conical *Actæoninæ* (*Cylindrobullina*). In Yorkshire it occurs chiefly in the uppermost horizon of the Inferior Oolite. I have a specimen in my Collection from the Dean and Chapter Pit at Lincoln (*Murchisonæ*-zone) 22 mm. in height. On the higher horizons of the Lincolnshire Limestone at Wansford and Weldon, and also at Barnack, smaller specimens like fig. 22, and still smaller ones, are by no means rare.

421. ACTÆONINA (CYLINDROBULLINA) CINEREA, *Hudleston*, 1885. Plate XLIII, figs. 1 a, 1 b.

1885. ACTÆONINA CINEREA, *Hudleston*. *Geol. Mag.*, 1885, p. 206, pl. v, figs. 8, 8 a.

*Description :*

Height . . . . .	10—25 mm.
Body-whorl to total height . . . . .	80 : 100.
Spiral angle . . . . .	90°.

Shell cylindro-conical, with a regular spire about one-fifth the total height. The angle of increase is exactly a right angle; apex obtuse. Whorls of the spire five, short, sub-tumid, and smooth, with a well-marked posterior tabulation or ledge, which is also very conspicuous on the body-whorl. Body-whorl relatively large and cylindrical, sides compressed. Aperture two-thirds of the total height, narrow with very straight outer lip, and rounded off anteriorly; columella smooth. More or less flexuous growth-lines are visible on some specimens.

*Relations and Distribution.*—Near to *Actæonina glabra*, of which this may be considered a broad variety with a somewhat higher spire and more distinct tabulation. On the other hand, the rectangular outline of the whorls and shorter spire serve to separate it from *Act. Scarboroughensis*. Not uncommon in the Scarborough Limestone.

422. ACTÆONINA GIGANTEA, *Deslongchamps*, 1842. Plate XLIII, figs. 2 and 3, var. *attenuata*, fig. 4.

1842. TORNATELLA GIGANTEA, *Deslongchamps*. *Mém. Soc. Linn. Norm.*, vol. vii, p. 137, pl. x, figs. 27 and 28.

1851.	ACTÆONINA GIGANTEA,	<i>Deslongchamps.</i>	Morris and Lycett, Grt. Ool. Moll., part 1, p. 119, pl. xv, fig. 13.
1885.	—	—	Hudleston, Geol. Mag., 1885, p. 203.
1895.	—	—	Cossmann, Gast. Terr. Jur., p. 22, pl. ii, figs. 12, 13.
Syn.	—	DESLONGCHAMPSII, <i>d'Orbigny.</i>	Terr. Jur., vol. ii, p. 171, pl. cclxxxvi, fig. 11.

*Bibliography, &c.*—The Normandy specimens (Bathonian) are mainly casts. The very large specimens from the Inferior Oolite of the Yorkshire coast are broader than the French types. This is one of the few species for which the generic name, *Actæonina*, is retained by M. Cossmann.

*Description.*—The specimens from our Inferior Oolite are variable as to size and shape. The Yorkshire specimen figured by Morris and Lycett has a height of 40 mm., whilst the specimens figured in the accompanying plate do not exceed 25 mm. The spiral angle may be said to range from 52° to 60°, whilst the body-whorl is generally less than two-thirds the total height.

The shell is oval, thin, and smooth, whorls (seven or eight) rather flattened at the sides, sub-convex, with the posterior tabulation slightly rounded off; aperture narrow above, dilated below, and about three-fifths the entire length.

*Relations and Distribution.*—This may be taken as an average representative of the genus *Actæonina*, closely related to the cylindro-conical forms (*Cylindrobullina*), yet passing by protraction into such forms as *Actæonina acuta*, d'Orb. Besides the Yorkshire specimens, there are some from the *Parkinsoni*-zone of the Cotteswolds (fig. 2), which are rather short in the spire and approaching *Act. Scarburgensis*. This variety of *Act. gigantea* I have noticed on several horizons and localities of the Inferior Oolite; it is an intermediate form.

Fig. 3 from the Dean and Chapter Pit at Lincoln (*Murchisonæ*-zone) may be taken as a small but more typical representative of the species; whilst in Fig. 4 (specimen also from Lincoln), where the spiral angle is reduced to 45°, we have the variety *attenuata*, which might almost be regarded as a distinct species.

423. ACTÆONINA OVATA, *Lycett*, 1850. Not figured.

1850.	ACTÆONINA OVATA,	<i>Lycett.</i>	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 418.
1853.	—	—	Proc. Cotteswolds Nat. Club, vol. i, p. 79.

This species is not enumerated by Morris nor by Hudleston and Wilson. There is one very poor specimen in the Jermyn Street Museum, from the Inferior

Oolite of Gloucestershire, which may be the type. Two micromorphs from the Lincolnshire Limestone of Weldon seem to answer to Lycett's diagnosis, which is as follows:

"Ovate; spire of moderate elevation, consisting of four flattened whorls, last whorl subcylindrical, large; aperture lengthened, oblique."

424. *ACTÆONINA TUMIDULA*, *Lycett*, 1850. Plate XLIII, fig. 5 and ? fig. 9.

1850.	<i>ACTÆONINA TUMIDULA</i> , <i>Lycett</i> .	<i>Ann. Mag. Nat. Hist.</i> , 2nd ser., vol. vi, p. 418.
1851.	— —	<i>Morris and Lycett</i> . <i>Grt. Ool. Moll.</i> , part 1, p. 120, pl. xv, fig. 14.
1885.	— —	— <i>Hudleston, Geol. Mag.</i> , 1885, p. 205, pl. v, fig. 7.
? Syn.	—	<i>DAVOUSTANA, d'Orbigny</i> . <i>Terr. Jur.</i> , vol. ii, p. 169, pl. cclxxxvi, figs. 5, 6.

*Description* by Morris and Lycett.—"Shell small, spire depressed, volutions very narrow, rounded, their sutures deeply depressed; the last whorl gibbous, aperture an elongated oval. This species is shorter than any other with which we are acquainted." The height of the type is about 10 mm. and the spiral angle 100°.

Fig. 5 represents the specimen from the Bean Collection at the British Museum, which is believed to be the Yorkshire type, though somewhat different to the figure given by Morris and Lycett. It is obviously much broken away anteriorly. Lycett had previously described the species from the Inferior Oolite of Gloucestershire, but no specimens are forthcoming. Very rare in the Scarborough Limestone of White Nab.

Fig. 9, representing a small *Trochactæonina*, may possibly be the same species with the anterior portion of the aperture preserved.

425. *TROCHACTÆONINA* cf. *ESPARCYENSIS*, *d'Archiac*, 1843. Plate XLIII, fig. 8.

1843.	<i>CASSIS ESPARCYENSIS</i> , <i>d'Archiac</i> .	<i>Mém. Soc. Géol. France</i> , vol. v, p. 385, pl. xxxi, fig. 10.
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A single specimen from the Lincolnshire Limestone of Weldon, though only a micromorph 10 mm. in height, has considerable resemblance to this well-known Bathonian species. The spire is even more depressed than in *Actæonina tumidula*, whilst the body-whorl is broader atop and more pyriform in outline.



426. ACTÆONINA ANTIQUA, *Lycett*, 1857. Plate XLIII, fig. 6.

1859. ACTÆONINA ANTIQUA, *Lycett*. Cotteswold Hills, p. 125, pl. iv, fig. 9.<sup>1</sup>

*Description*.—The height of the figured specimen is 38 mm. Shell oblong, thin, with an obtuse apex and short spire of about four or five volutions; the spire is from one sixth to one seventh of the total height; whorls rounded upon their upper borders. Aperture elongate, narrow above and expanded anteriorly; columella curved and emarginated at its base.

The above is a slight modification of *Lycett*'s original diagnosis.

*Relations and Distribution*.—The proportions bear some resemblance to those of *Actæonina glabra*, though in this case the spire is shorter and the figure of the body-whorl is somewhat different. The type is from the *Spinosa*-stage of Rodborough Hill, and is the only specimen of that size which has come under my notice. Smaller specimens, when compared with *Actæonina glabra*, exhibit a shorter spire than that species.

427. ACTÆONINA (?) CONVOLUTA, *Lycett*, 1857. Plate XLIII, fig. 7.

1857. ACTÆONINA CONVOLUTA, *Lycett*. Cotteswold Hills, p. 125, pl. iv, fig. 8.

*Description*.—The height of the figured specimen is 35 mm. "Shell oblong, rather compressed at the sides; spire depressed, scarcely produced, consisting of five volutions, which embrace each other and rise but little above the body-whorl; apex obtuse; aperture lengthened, very narrow above, more expanded towards the base; columella curved at the base, emarginated and slightly twisted."

*Relations and Distribution*.—The tendency of *Actæonina* in the direction of the Bullidæ seems to reach a maximum in this curious form. As pointed out by *Lycett*, it differs from *Bulla primæva*, Deslongchamps, in its more cylindrical figure and in the fact that the spire is slightly prominent, and not sunk in an apical cavity.

The type is from the *Spinosa*-stage of Rodborough Hill. I have a characteristic specimen from the *Clypeus*-grit of Aston Farm, and a smaller one from the Rag of Cleeve Hill, all in the *Parkinsoni*-zone. In these specimens the outer lip is straighter than in the figured specimen, which in this respect is rather misleading.

<sup>1</sup> In *Lycett*'s plate the numbers referring to *Actæonina antiqua* and *Act. convoluta* have been transposed.



*Genus*—CYLINDRITES, *Morris and Lycett*, 1851.

"Shell smooth, sub-cylindrical, or ovate; spire small; whorls usually flattened, with acute margins, the last whorl cylindrical, aperture lengthened, linear above, rounded and entire at the base; columella rounded, twisted near to the base and slightly directed outwards; right lip thin, but thicker at the base."—MORRIS AND LYCETT.

This is chiefly a genus of the Great Oolite; the number of species in the Inferior Oolite is limited, and their distribution very partial. Considerable difficulty arises from the uncertain evidence with regard to the identification of Lycett's species from the Inferior Oolite of Gloucestershire. On the whole the species of *Cylindrites* may stand thus:

Turritid . . . . .	. <i>Cy. turriculatus</i> , Lycett.
Spire consisting of a low cone . . . . .	. { <i>Cy. attenuatus</i> , Lycett. <i>Cy. brevispira</i> , sp. nov.
Spire flat or subdepressed, with a mam- millary knob . . . . .	. { <i>Cy. tabulatus</i> , Lycett. — var. <i>Weldonis</i> . <i>Cy. mammillaris</i> , Lycett.
Spire sunken . . . . .	. <i>Cy. cylindricus</i> , Morris and Lycett.

428. CYLINDRITES TURRICULATUS, *Lycett*, 1853. Plate XLIII, fig. 12.

1853.	CYLINDRITES TURRICULATUS, <i>Lycett</i> .	Quart. Journ. Geol. Soc., vol. ix, p. 342, pl. xiv, fig. 8.
1863.	— — — — —	Great Ool. Moll., Suppl., p. 25, pl. xlv, fig. 26.

*Description*.—"Shell elongated, subcylindrical; spire lengthened, its apex acute; whorls convex, their sutures deeply excavated, the last whorl ovately cylindrical; aperture narrow." Lycett's type is not available, nor have I seen a specimen so large as the one figured by him. My specimen (fig. 12) has a spiral angle of 60°, and no more than six whorls; the spire is nearly one third of the total height.

*Relations and Distribution*.—Probably only a small variety of *Cylindrites altus*, Morris and Lycett, from the Great Oolite, but less cylindrical, and with the posterior edge of the whorls less flattened. Rare in the Lincolnshire Limestone at Ponton and Weldon, it is the only species of *Cylindrites* from the Inferior Oolite which has a well-developed spire.

429. CYLINDRITES ATTENUATUS, *Lycett*, 1850. Plate XLIII, figs. 15 *a*, 15 *b*.

1850. CYLINDRITES ATTENUATUS, *Lycett*. Ann. Mag. Nat. Hist., 2nd ser., vol. vi,  
p. 418.

1853. — — — — Proc. Cotteswold Nat. Club, vol. i,  
p. 79.

Syn. — GRADUS, *Lycett*. Op. et. vol. cit.

Cf. also — GRADATUS, *Cossmann*, Gast. Terr. Jur. p. 76, pl. iii, fig. 50.

*Description*.—Height 8 to 10 mm. and about two and a half times as long as wide; the shell is cylindro-conical, with a short conoidal spire, consisting of about six whorls which are narrow and step-like, with sharp edges. The body-whorl is flattened and attenuated towards the base. The posterior portion of the aperture is extremely narrow, and the twist on the columella not very strongly marked.

*Relations and Distribution*.—The strongly step-like character of the spire-whorls is a characteristic feature. Rare in the Inferior Oolite at Leckhampton.

## 430. CYLINDRITES BREVISPIRA, sp. nov. Plate XLIII, figs. 17 and 18.

*Description*.—Height 6.4 mm., width 4 mm. Shell sub-cylindrical, wide at top and much narrowed towards the anterior extremity. The spire is very low, but the margin of each spire-whorl projects slightly beyond the margin of the body-whorl, so that the figure of the spire is that of a very depressed, though regular cone. There are about six whorls in all, the margin of each presenting a sharp upturned edge with a slight hollow between. The body-whorl is pyriform.

*Relations and Distribution*.—Differs from *Cy. attenuatus* in its pyriform rather than cylindrical shape, its greater proportional width, and in having a still more depressed spire, whose whorls also are less flattened. Bears some resemblance to *Cy. bullatus*, Morris and Lycett, but in that species the spire is sunken.

There are five specimens in my Collection from the Lincolnshire Limestone of Weldon.

431. CYLINDRITES TABULATUS, *Lycett*, 1850. Plate XLIII, figs. 14 *a*, 14 *b*, and var. *Weldonis*, figs. 13 *a*, 13 *b*.

1850. CYLINDRITES TABULATUS, *Lycett*. Ann. Mag. Nat. Hist., 2nd ser., vol. vi,  
p. 418.

1853. — — — — Proc. Cotteswold Nat. Club, vol. i,  
p. 79.

*Bibliography, &c.*—The type is preserved in the Jermyn Street Museum. It cannot be said to correspond very closely with Lycett's diagnosis.

*Description.*—(Based upon the specimen in the Jermyn Street Museum.) Height 17 mm., width 9 mm. Shell cylindrical, but tapering anteriorly. The spire, consisting of about five whorls, is nearly flat and slightly sunken, but with a prominent mammilliform apex of considerable size. The posterior margin of the body-whorl is flattened and encloses the spire, the dividing suture lying in a deep groove. The columellar lip is strongly twisted.

The var. *Weldonis* is a fossil of much smaller habit, the usual height being 8 mm., width 4 mm. It is also somewhat more pyriform in figure.

*Relations and Distribution.*—Belongs to the section of *Cylindrites* which have sunken spires. Differs from *Cy. mammillaris* in the extensive flattening of the posterior margin of the body-whorl, and in the groove which divides this from the spire-whorls; it is also rather broader in proportion to its length.

The specimen in the Jermyn Street Museum, from the Inferior Oolite of Nailsworth, is the only one I have seen from the Cotteswolds. The var. *Weldonis* is the most abundant *Cylindrite* in the Lincolnshire Limestone at Weldon and Ponton.

#### 432. CYLINDRITES MAMILLARIS, Lycett, 1850 (not figured).

1850. CYLINDRITES MAMILLARIS, Lycett. Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 418.

1853. — — — — — Proc. Cotteswold Nat. Club, vol. i, p. 79.

*Description.*—Height 20 mm., width 8 mm. in a good-sized specimen. Shell cylindrical, elongate, sharply truncated atop. Spire flattened and sub-depressed, but the inner whorls have their upper flat surfaces visible, the first two or three of which are rounded into a mammillary knob. Aperture elongate with a strong columellar fold.

*Relations and Distribution.*—This is an extremely narrow and cylindrical form, only differing from *Cy. cylindricus*, Morris and Lycett, in the salience of the mammillary knob and in the flattening, rather than depression, of the spire.

There are two specimens of *Cy. mammillaris* in the Brodie Collection from the Leckhampton Freestones. A variety, approaching *Cy. cylindricus*, also occurs sparingly in the Lincolnshire Limestone of Weldon. This has been quoted as *Cy. cylindricus*.



433. CYLINDRITES CYLINDRICUS, *Morris* and *Lycett*. Inferior Oolite variety. Plate XLIII, figs. 16 a, 16 b.

In this form the upper margin of the last whorl slopes slightly inwards, and encloses the spire-whorls within the depression thus formed, so that even the central mammilla is sunken.

The figured specimen is thought to be from Nailsworth. It is preserved in the Inferior Oolite collection of the Jermyn Street Museum, and is the only one I have ever seen from that formation.

*Family*—BULLIDÆ.

"Shell globular or cylindrical, convoluted, thin, often punctate-striated; spire small or concealed; aperture long, rounded and sinuated in front, lip sharp."—S. P. WOODWARD.

The few representatives of this family (now broken up into Bullidæ, Aceridæ, and Aplustridæ) in the Inferior Oolite may provisionally be retained under *Bulla* without prejudice to their being recognised as *Hydatina* or *Acera*.

*Genus*—BULLA, *Linnæus*, 1758.

434. BULLA FAVREI, *Lycett*, 1857. Plate XLIII, fig. 10.

1857. BULLA FAVREI, *Lycett*. Cotteswold Hills, p. 125, pl. iv, fig. 7.

*Description*.—Height 36 mm., width 28 mm.

Shell ovate, ventricose or pyriform, summit contracted, and partially concealing the inner whorls, the first of which is slightly elevated. The columellar lip is drawn out anteriorly and sinuous. Aperture widely ovate anteriorly, and but moderately contracted posteriorly.

*Relations and Distribution*.—The mammillary apex and extension of the columella easily serve to separate this shell from *Bulla undulata*, Bean. Indeed, they may be generically distinct. A single specimen from a high horizon in the *Spinosa*-stage near Avening, a village not far from Minchinhampton.



435. BULLA (HYDATINA) UNDULATA, *Bean*, 1839. Micromorphic variety. Plate XLIII, figs. 11 *a*, 11 *b*.

1839. BULLA UNDULATA, *Bean*. Ann. Mag. Nat. Hist., n. s., vol. iii, p. 61, fig. 22.

1851. — — — Morris and Lycett, Grt. Ool. Moll., part 1, p. 96,  
pl. viii, figs. 8, 8 *a*.

Height 6·5 mm., extreme width 5 mm.

Besides being considerably smaller than *Bean*'s species, this variety is rather wider in proportion to its height, but in other respects it would be difficult to separate them. But cf. *Bulla globulosa*, *Cossmann*. A single specimen in my Collection from the Scarborough Limestone.

There is a specimen, also in my Collection, from the Inferior Oolite near Radstock, which has a height of 10 mm., and whose proportions accord better with those of *Bulla undulata*.

## S U P P L E M E N T .

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DURING the period that the Monograph on the Inferior Oolite Gasteropoda has been in course of publication, a certain number of specimens have been noticed or procured too late to be recorded in their proper places. They are mostly rare forms, and in some cases the genus is doubtful. These it is now proposed somewhat briefly to describe, in most cases with a figure. See Plates XLIII and XLIV.

436. PURPUROIDEA, species. Plate XLIV, fig. 9.

A single fragment of a large *Purpuroidea* was recently obtained from the Lincolnshire Limestone at Rauceby. There is not enough material to constitute a species, but the circumstance is interesting from its being the only instance of *Purpuroidea* as yet recorded from the Inferior Oolite of this country.

Though apparently differing from any of the Great Oolite species, it most nearly resembles *P. Morrisæ*, Buvignier, which is the common form at Minchinhampton. Possibly also some of the Corallian species described by Buvignier, such as *P. Moreana*, may be near.

437. PURPURINA VARICOSA, *Lycett*, 1850. Not figured.

1850.	TURBO VARICOSUS, <i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 416.
1853.	— — —	Proc. Cotteswold Field Club, vol. i, p. 77.

The following is *Lycett's* description:—"Turrited, whorls six, convex, each with four encircling, rounded and smooth costæ, crossing about eight large longitudinal elevations, which pass rather obliquely from left to right: axis two lines."

From want of evidence "*Turbo*" *varicosus* was not listed either by Morris

or by Hudleston and Wilson. Quite recently the Brodie Collection of fossils from the Leckhampton Freestones has been acquired for the Jermyn Street Museum. A specimen marked "*Turbo*, n. sp., 34," answers fairly well to Lycett's description, so far as the whorls of the spire are concerned. This is evidently a *Purpurina*, and has some resemblance to the form on Pl. I, fig. 2, of this Monograph.

438. *BRACHYTREMA PONTONIS*, sp. nov. Plate XLIII, figs. 21 *a*, 21 *b*.

*Description:*

Height	.	.	.	.	.	14 mm.
Spiral angle	.	.	.	.	.	65°.

Shell thick, trochiform, imperforate. The spire and body-whorl are nearly equal in height, and the spiral angle perfectly regular. Number of whorls five or six, sutures well-marked; the spire-whorls carry three sub-nodular spiral bands. The body-whorl is large and bicarinate owing to the prominence of the second and third spirals; number of spirals in the base about five.

The aperture is quadrangular with the columella considerably produced and slightly curved, and terminated at the point by a conspicuous reflexed notch or gutter.

*Relations and Distribution.*—This curious shell has a strong resemblance to *Littorina Phillipsii*, except as regards the aperture. A single specimen from Great Ponton.

439 ? *BRACHYTREMA* "PRÆTENUÆ." Plate XLIII, figs. 24, 24 *b*.

*Description:*

Height	.	.	.	.	.	3 mm.
Spiral angle	.	.	.	.	.	32°.

Shell minute, conical-elongate, imperforate. There are about six whorls, flat and close, though the sutures are fairly distinct. The ornaments consist of fine spiral lines decussating with nodular longitudinal lines, slightly variciform. The body-whorl is about one-third the total height. Aperture subquadrate with a reflexed notch at the columellar extremity.

*Relations and Distribution.*—More acute than any other species of *Brachytrema*, this might almost be regarded as a *Cerithium*, though the style of ornamentation connects it with *Brachytrema*. A single specimen from the Oolite Marl, Notgrove.

440. *CERITHIUM* (*COLINA*<sup>1</sup>) *LYCETTI*, sp. nov. Plate XLIII, figs. 22 *a*, 22 *b*.*Description :*

Height . . . . .	15 mm.
Body-whorl to total height . . . . .	35 : 100.
Spiral angle . . . . .	35°.

Shell sub-fusiform; apex sharp; spire regular; number of whorls eight, sutures close fitting. The ornaments consist of wide-apart longitudinal varices, which are decussated by strong spiral lines, slightly nodular.

The body-whorl is considerably expanded so as to make the outer lip patulous. The longitudinal varices are scarcely to be traced in the body-whorl, which is ornamented by numerous spiral ribs, expanding outwards with the increase of the whorl and causing the margin of the lip to be crenulate. The aperture is oblique with a full and rounded outer lip, somewhat flattened anteriorly, with a sinuous and rather encrusted columella, which terminates in a broad, short notch turned outwards almost at right angles to the axis of the shell.

*Relations and Distribution.*—This form is very different to the general facies of the shells in the Inferior Oolite which have been referred to *Cerithium*. It is suggestive of *Pyrazus* and other sub-genera of *Potamides*, but these are at least brackish-water shells. On the other hand, its resemblance to such shells as *Cerithium* (*Colina*) *contractum*, Sow., and *Cerithium* (*Colina*) *tæniatum* from the Indian Ocean (Natal) is very striking. Provisionally we may refer the Oolite specimens to *Colina*. Mr. Wilson considers that, possibly, there is a generic affinity between *C. Lycetti* and the Upper Lias *Nortonia Patroclus*.

From Nailsworth (Oolite Marl or Pea-grit) there are four specimens in the Jermyn Street Museum (Lycett Collection). The figured specimen is the most elongate.

441. *BRACHYTREMA*, sp. Plate XLIII, fig. 23.

An imperfect specimen with an estimated height of 15 mm. and a spiral angle of 40°. The aperture, which happens to be well-preserved, is widely sub-quadrate with an effuse outer lip; columella much twisted near the base, with a broad gutter or notch directed outwards at an angle of 45°. There is strong granulated spiral ornamentation throughout the shell, which appears to have been very thick.

This seems to be a typical *Brachytrema*. A single specimen from the Irony Nodule-bed, Burton Bradstock.

<sup>1</sup> H. and A. Adams, 1853.



442. ? *FIBULA VELOX*, sp. nov. Plate XLIV, figs. 7 a, 7 b.

*Description :*

Height . . . . .	11 mm.
Spiral angle . . . . .	42°.

Shell smooth, conical-subelongate, solid; apex acute, spiral angle regular. Number of whorls six; height of spire and of body-whorl nearly equal. The whorls are flat towards the apex, becoming gradually more convex, whilst the body-whorl is sub-tumid, with a rounded periphery; the whorls are quite smooth, with close sutures. The aperture is angular and oblong, the columella being considerably drawn out with a slight anterior twist, terminating in a somewhat ill-defined notch.

*Relations and Distribution.*—The true relations of this curious shell are not very obvious. A single specimen from the *Murchisonæ*-zone of the Cotteswolds; most probably from the Oolite Marl of Swift's Hill or Longridge.

443. *CERITELLA TUMIDULA*, *Lycett*, 1850. Not figured. And var. *angusta*. Plate XLIII, fig. 26.

1850.	<i>CERITELLA TUMIDULA</i> , <i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 419.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 86.

*Description :*

Height . . . . .	11 mm.
Body-whorl to total height . . . . .	38 : 100.
Spiral angle . . . . .	30°.

The following is *Lycett's* diagnosis: "Small, smooth, much lengthened; whorls flattened, but slightly tumid at their upper junctions; body-whorl symmetrical."

The number of whorls in the type-specimen (Brodie Collection) is eight; the thickening of these on the posterior margin produces a slight ledge at the suture (hence the name *tumidula*, otherwise inappropriate).

*Relations and Distribution.*—Closely related to *Ceritella Sowerbii*, *Morris* and *Lycett*, a Great Oolite species, though somewhat more slender than the majority of these. In fact, *C. Sowerbii* is merely a variety of *C. tumidula*. Rare in the shelly freestone at Leckhampton.

The var. *angusta* (fig. 26) has a height of 5 mm., and a spiral angle of 24°.

and may be regarded as a slender micromorph of Lycett's species. A single specimen from the Lower Limestone (below the Pisolite horizon) at Nailsworth. Cf. *Ceritella minutissima*, Lycett, Grt. Ool. Moll., Suppl., Plate 45, fig. 5.

N.B.—*Ceritellæ* of this group are not always easy to distinguish from the early stage of certain species of *Nerinæa*.

444. *CERITELLA STOKENSIS*, sp. nov. Plate XLIII, fig. 25.

*Description:*

Height . . . . .	5 mm.
Body-whorl to total height . . . . .	70:100.
Spiral angle . . . . .	60°.

Shell smooth and sub-globose, consisting of about five whorls; apex sharp; the whorls of the spire are narrow and flat, with a close but distinct suture. There is a slight ledge on the posterior margin of the body-whorl, which is tumidly elongate, being very large in comparison with the spire. The aperture is oval-elongate, outer lip thin, columella curved, and terminating in a wide notch, which is slightly reflexed.

*Relations and Distribution.*—This form differs completely from any species of *Ceritella* known in this country. A single specimen from the Lincolnshire Limestone at Stoke Lodge.

445. *CERITHINELLA*, sp. Plate XLIV, figs. 5, 6 *a*, 6 *b*.

The lower beds of the Lincolnshire Limestone have yielded some fragments of *Cerithinella*, a genus not hitherto noted in the East Midland district. In external ornamentation these specimens serve to remind me of *Cerithinella Brodiei*. The section (fig. 5) has slight indications of a fold in the outer wall as in *Nerinella*.<sup>1</sup>

446. *NERINÆA* (*NERINELLA*) *NEGLECTA*, sp. nov. Plate XLIV, figs. 4 *a*, 4 *b*.

*Description:*

Height . . . . .	12 mm.
Spiral angle . . . . .	30°.

Shell conical-elongate, turrited, with a somewhat convex spiral angle. Number of whorls about eight, narrow, without visible ornament, but much thickened at the posterior margin, so as to cause a marked increase or turreting of

<sup>1</sup> For an account of *Nerinæa* (or *Cerithinella*) *cingenda*, Sowerby, figured on Plate XII of this Monograph, see 'Geol. Mag.,' dec. iii, vol. i, p. 112, pl. iv, figs. 9 and 9 *a*.

each successive whorl. The body-whorl occupies one third of the total height, and is somewhat bicarinate. All the whorls, including the body-whorl, are slightly convex and very smooth. The aperture is quadrate, with a short thick columella, and wide anterior notch. A fold on the inner and outer walls of each whorl.

*Relations and Distribution.*—This species belongs to the biplicate section of *Nerinella* (see p. 198, and Pl. XIII, figs. 1 and 2, of this Monograph). It is much broader than either of the two unnamed forms there described. Consequently the shape of the whorl in section is much more squat.

There are two specimens in my Collection from the Lincolnshire Limestone of Weldon, and others which seem to connect with the narrower forms.

447. *NERINÆA* (*PTYGMATIS*) cf. *CINGENDA*, *Phillips*. Plate XLIV, figs. 8, 8 a, 8 b.

Specimens of an elongate *Nerinæa*, not unlike *N. cingenda*, occur somewhat plentifully in the Lincolnshire Limestone at Stoke Lodge. In this case the internal section is that of a *Ptygmatis* with five folds. The specimens greatly resemble a variety provisionally named "*pseudocingenda*" (see p. 212, Pl. XIV, fig. 15, of this Monograph). Bearing in mind that sections of Dogger specimens of *Nerinæa cingenda* are liable to mislead, the Stoke Lodge fossils may possibly represent the true internal structure of this species.

*Genus*—*PALUDINA*, *Lamarck*, 1812.

*Shell turbinated with round whorls, thin; aperture circular, slightly angular behind, peristome continuous, entire; operculum horny, concentric.*

Conchologists have expressed a doubt whether *Paludina* extends as far back as the Jurassic. Yet *Paludina* occurs abundantly in the Upper Purbecks. Neither can we doubt that *Paludina scotica*, Tate ('Quart. Journ. Geol. Soc.,' vol. xxix, p. 349, pl. xii, fig. 3), from the Infra-Oxfordian beds of Loch Staffin, is correctly referred to that genus.

448. *PALUDINA* *LANGTONENSIS*, sp. nov. Plate XLIV, figs. 1 a, 1 b.

*Description:*

Height (full size)	.	.	.	30 mm.
Body-whorl to total height	.	.	.	60 : 100.
Spiral angle	.	.	.	62°.

Shell smooth, turbate, often rather dark in colour, and with a considerable



umbilical furrow. Number of whorls five to six. These are very tumid and separated by a deeply impressed, almost canaliculate suture; sutural angle very oblique. No ornamentation, other than growth-lines, which are rugose and varix-like on the body-whorl. Aperture nearly circular with thin sharp lips.

*Relations and Distribution.*—This species resembles in some respect *Paludina scotica*, which occurs in the Hebrides on approximately the same horizon. It also differs but little from *Paludina vivipara*, being perhaps of smaller habit and with a more sloping sutural angle and more convex whorls than the existing species. On the other hand the *Paludinas* of the Upper Purbeck are for the most part very different.

*Paludina Langtonensis* is abundant in the so-called *Paludina*-bed, a kind of mortar-like deposit which occurs high up in the Chipping Norton limestone at Langton Bridge, along with other freshwater species and occasionally seeds of *Chara*, &c. But associated with these are species of *Cerithium* and *Nerinæa* along with a small variety of *Amberleya nodosa*—apparently a Bathonian fauna. This deposit, where developed, is found to underlie a gritty bed containing teeth and palates of fish.

*Paludina Langtonensis* also occurs in great abundance at Castle Barn, three and a half miles from Chipping Norton, and traces may likewise be seen at Sharp's Hill in a similar position.

*Genus*—VALVATA, Müller, 1774.

*Shell umbilicated, turbinoid, or subdiscoidal, spire but slightly prominent, whorls convex and few; aperture circular, oblique; peristome entire, thin, sharp, slightly expanded.*

449. VALVATA COMES, sp. nov. Plate XLIII, fig. 27; and Plate XLIV, figs. 2 a, 2 b.

The transverse diameter of these little shells does not exceed 3 mm. Judging from the figure they differ slightly from *Valvata præcursor*, Tate ('Quart. Journ. Geol. Soc,' vol. xxix, p. 348, pl. xii, fig. 9). The spire is more salient than in *Valvata cristata*.

Somewhat rare in the *Paludina*-bed at Langton Bridge.



## 450. CIRRUS, species or variety. Plate XLIV, fig. 12.

The interest of this specimen consists in the fact that it is the only one of the genus known to me from the Lincolnshire Limestone (Stoke Lodge). It may possibly be a micromorph of *Cirrus Leachi*.

451. ONUSTUS PILEUS, *Lycett*, 1850. Not figured.

1850.	TROCHUS PILEUS, <i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 417.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 78.

The following is *Lycett's* diagnosis. "Very elevated; whorls few, concave, with longitudinal elevations united at the base, and overwrapping the upper portion of the succeeding whorl, base discoidal." Further on he adds that this will probably be erected into a new genus.

There is a single specimen in the Brodie Collection, the apical whorls alone being preserved. It is clearly a species of *Onustus*, related to *O. acuminatus*, Hudl. There are two much larger specimens, also from the Cotteswolds, which have been in the Jermyn Street Museum for some years (see p. 328, supra). These may be referred to *Onustus pileus*, *Lycett*.

## 452. DELPHINULA OR MARGARITA, species. Plate XLIV, figs. 3 a, 3 b.

This form has considerable resemblance to *Delphinula (Turbo) Santonis*, Hudl., differing principally in details of ornamentation. At the same time I would scarcely refer to it as absolutely the same species.

A single specimen, said to come from Cold Comfort in the Cheltenham district.

453. DELPHINULA QUATERNO-CINGILLATA, *Lycett*, 1850. Not figured.

1850.	DELPHINULA QUATERNO-CINGILLATA, <i>Lycett</i> .	Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 416.
1853.	— — —	Proc. Cotteswold Nat. Club, vol. i, p. 77.

This is a doubtful species, since the two specimens thus marked in the Brodie Collection differ in more than one respect from the diagnosis, which is as follows:—"Subglobose, spire of several whorls, angulated; longitudinal costæ large, elevated, rather angular, impressed by numerous transverse (spiral) lines; umbilicus costated; aperture orbicular."

## CHILODONTOÏDEA, genus nov.

Shell short, thick, eucycloid, slightly pupæform, imperforate. Whorls irregular, the anterior ones carinate; body-whorl considerably shorter than the spire; ornamentation subreticulate. Aperture externally quadrate and oblique, with a double callosity on the columella, which is dentate at the angle; a broad callosity inside the outer lip further restricts the aperture internally.

There are many points of resemblance between this curious genus and *Chilodonta*, Étallon, which, however, is represented as having five internal teeth or callosities. The Corallian genus also has a more distinctly trochiform spire, though the character of the ornamentation is somewhat similar. Fischer ('Manuel,' p. 818) makes *Chilodonta* a sub-genus of *Clanculus*, one of the Trochidæ. In this connection the following references may be useful.

*Chilodonta clathrata*, Étallon. Corallien du Haut Jura ii, p. 54.

*Trochus (Monodonta) clathratus*, Étallon. Zittel, Gast. Stramb. Schicht, p. 329, pl. xlviii, figs. 27 and 28.

*Chilodonta clathrata*, Étallon. De Loriol, Mém. Soc. Pal. Suisse, vol. xvii (1890), p. 147, pl. xvi, fig. 15.

## 454. CHILODONTOÏDEA OOLITICA, sp. nov. Plate XLIII, figs. 19, 20 a, 20 b.

*Description:*

Height	.	.	.	.	.	9 mm.
Body-whorl to total height	.	.	.	.	.	35 : 100.
Spiral angle irregular and convex.						

The apex is sharp; number of whorls eight, flat to subconvex in the early stages, strongly carinate in the later ones, and separated by a deep suture. The ornaments in the upper part of the whorls consist mainly of delicate and rather sinuous axial lines, which on the keels produce a fine granulation; in the anterior portion of the whorls the ornaments are chiefly spiral. The shell gapes somewhat between the penult and body-whorl, which latter is stumpy, and towards the aperture its upper margin encroaches on the penult. The body-whorl is carinate and spirally ornamented on the base. There are, however, considerable differences in ornamentation according to locality.

The characters of the aperture are those of the genus.

*Relations and Distribution.*—The distinction between this form and *Chilodonta*

*clathrata* have already been partially indicated. Attention is also drawn, in the accompanying footnote, to another form, lately found in the Lias of Thorncombe, which evidently belongs to the same group, though generically, or at least subgenerically, distinct.<sup>1</sup>

*Chilodontoïdea oolitica* is a rare species, yet it occurs on the same horizon at four localities, viz. the *Concavus*-bed at Bradford Abbas and the Irony Nodule-bed of Burton Bradstock; also at Beaminster and Stoford.

455. FOSSARUS (COUTHOUYA<sup>2</sup>) OOLITICUS, sp. nov. Plate XLII, fig. 17.

*Description :*

Height . . . . .	13 mm.
Body-whorl to total height . . . . .	70 : 100.
Spiral angle . . . . .	60°.

An ovate elongate shell with a short spire and few whorls, which are non-embracing. A very slight umbilical fissure. The entire shell is ornamented with strong spiral ribs, regular and equidistant. Aperture a lengthened oval, with an arched and crenulated outer lip, expanded anteriorly, and a long and almost straight columellar lip. The entire peristome is thick.

*Relations and Distribution.*—There is very little difference between this shell and the existing *Couthouya reticulata*, A. Adams, from the China seas. The modern shell has a better developed umbilical fissure, and is rather smaller; *Isapis fenestrata*, Carpenter, from the west coast of North America, is also very near.

A single specimen from the *Concavus*-bed, Bradford Abbas.

<sup>1</sup> In order to find a place for the Lias shell, I propose to constitute the genus *Wilsonia*, thus named in honour of Edward Wilson, Esq., F.G.S., Curator of the Bristol Museum, who is our chief authority on the Gasteropoda of the Lias. The following is the diagnosis:

*Shell small, very thick, irregularly pupæform, imperforate, whorls increasing irregularly and scarcely convex, separated by a distinct but rather narrow suture. Ornaments pronounced, consisting of four or five granular spiral belts in each whorl, with fine intermediate axial decussation. Body-whorl rather shorter than the spire and compressed. Aperture sub-circular, with a thick outer lip and two prominent teeth towards the middle of the short columella.*

*Wilsonia liassica*, sp. nov. (Plate XLIV, figs. 13 a, 13 b, 13 c), has seven or eight whorls and a total height of about 14 mm. The prominence of the penult, which quite equals the body-whorl in width, is a characteristic feature; the ornamentation is very rich. A single specimen from the "junction-bed," Thorncombe, Dorset.

In *Wilsonia* the aperture possesses two distinct teeth; in *Chilodontoïdea* there are three callosities or teeth, and the internal portion of the aperture thus assumes a somewhat keyhole-like shape; in *Chilodonta* the aperture is restricted by five irregular teeth, and thus becomes still more fanciful in outline. We can scarcely doubt that these three genera (or sections) stand in ancestral relationship to each other, either linear or collateral.

<sup>2</sup> *Couthouya*, A. Adams, 1860, sub-genus of *Fossarus*, Philippi, 1841, member of the Littorinidæ. Cf. also *Fossariopsis*, Laube, from the Trias.



## TABLE I.

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### ALPHABETICAL INDEX OF THE INFERIOR OOLITE GASTEROPODA, WITH A TABLE OF DISTRIBUTION ACCORDING TO DISTRICTS.

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#### NOTE.

1.—As a rule no species are quoted in this Index unless based on specimens which have been seen by myself: *Nerinea consobrina*, Witchell, is perhaps the only exception. Forms provisionally named in the Monograph are not listed: exception, *Nerinea sub-brevivoluta*.

2.—Practically there are five districts: viz. (1) The Yorkshire Basin, *Lower* Division, including the Dogger and Millepore Bed; *Upper* Division, the Scarborough Limestone. (2) The East Midland District is not at present divided into a Lower and Upper Division; it embraces the Northampton Sand and Lincolnshire Limestone. (3) The Cotteswold District includes the Inferior Oolite outcrop from the neighbourhood of Banbury (Hook Norton) to the Mendip axis. The *Lower* Division comprises the *Opalinus*- and *Murchisonæ*-zones, including the Pea-grit, Oolite-marl, and the Freestones. It is probable also that the Gryphite-grit and Lower *Trigonia*-grit should come in here. The *Upper* Division includes the Upper *Trigonia*-grit and *Clypeus*-grit with their equivalents, lying for the most part in the *Parkinsoni*-zone. (4) The Dundry exposure is regarded as a district by itself, not at present divided. (5) The Dorset-Somerset District extends from the Mendip axis to the Channel at Burton Bradstock. The *Lower* Division includes the Yeovil Sands, together with the *Opalinus*-zone, *Murchisonæ*-zone, and *Concavus*-bed (in the early part of this Monograph called the *Sowerbyi*-bed). The *Upper* Division includes the *Sauzei*-bed, which is much more nearly on the *Sowerbyi*-horizon, the *Humphriesianus*-zone generally, and the *Parkinsoni*-zone.

3.—In the columns a “note of interrogation” (?) in some cases signifies that the identification is questioned, in others that the locality is in doubt. In those cases where an Upper and a Lower Division are adopted, the query may relate to the Division only. With respect to the East Midland District there is considerable difference between the Fauna of the Lower Division of the Lincolnshire Limestone, as exemplified by the extremely fossiliferous horizon at Lincoln, and the Fauna of the Upper Division, as exemplified by the beds at Weldon and Ponton; but since some fossiliferous localities are doubtful it has been thought best not to attempt to distinguish an Upper and Lower Division.



	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotteswolds.	Dundry.	Dorset—Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
<b>ACTÆON (<i>Tornatellæa</i>)</b>									
ooliticus, <i>Hudleston</i> .....	467	XLII, 11 .....			c			x	
pulchellus, <i>Deslongchamps</i> .....	466	XLII, 12, 13 .....							x
sculptus, <i>Lycett</i> .....	467	XLII, 10, 10 a .....						x	
<b>ACTÆONINA (<i>Striactæonina</i>, <i>Cylindrobullina</i>, <i>Trochactæonina</i>, &amp;c.)</b>									
antiqua, <i>Lycett</i> .....	477	XLIII, 6 .....					x		
cinerea, <i>Hudleston</i> .....	474	XLIII, 1 a, 1 b .....		x					
? convoluta, <i>Lycett</i> .....	477	XLIII, 7 .....					x		
cf. <i>Esparcyensis</i> , d' <i>Archiac</i> .....	476	XLIII, 8 .....			x				G. O.
gigantea, <i>Deslongchamps</i> .....	474	XLIII, 2, 3 .....		x	x		x		G. O.
— var. <i>attenuata</i> .....	475	XLIII, 4 .....			x				
glabra, <i>Phillips</i> .....	473	XLII, 22, 23 a, 23 b .....		x	x		x		
humeralis, <i>Phillips</i> .....	472	XLII, 20 a, 20 b .....		x		p		x	
ovata, <i>Lycett</i> .....	475	Not figured .....				p	p		
pulla, <i>Koch &amp; Dunker</i> , fide <i>M. &amp; L.</i> .....	470	XLII, 14 .....		x	x		x		
? <i>Sedgwicki</i> , <i>Phillips</i> .....	469	XLII, 15 .....		x					
subovalis, <i>Hudleston</i> .....	472	XLII, 21 .....						x	
tenuistriata, <i>Hudleston</i> .....	471	XLII, 18, 19, 19 a .....		x				x	
tumidula, <i>Lycett</i> .....	476	XLIII, 5 and ? 9 .....			x	x	p		
<b>ALARIA</b>									
angusta, <i>Hudleston</i> .....	111	IV, 2 .....						p	
arenosa, <i>Hudleston</i> .....	110	IV, 1 .....		x					
Doublieri, d' <i>Orbigny</i> .....	127	V, 11; VI, 1 a—c .....						p	x
Dundriensis, <i>Tawney</i> .....	122	V, 2 .....					x		
fusca, <i>Hudleston</i> .....	121	V, 3 .....							x
hamoides, <i>Hudleston</i> .....	140	VII, 7 a, b .....			x				
hamus, <i>Deslongchamps</i> .....	113	IV, 6 a—d, 7 a—c; VII, 9 .....					x		x
— var. <i>nodosa</i> .....	117	IV, 9 .....							p
— var. <i>Phillipsii</i> , d' <i>Orbigny</i> .....	116	IV, 8 a—c .....		x	x		x		
Lorieri, d' <i>Orbigny</i> .....	132	VI, 6 a—d; 6' a, b; 6'' a .....							x
— var. <i>gracilis</i> , <i>Lycett</i> .....	135	VI, 5 .....				x			
Lotharingica, <i>Schlumberger</i> .....	125	V, 9 .....						x	
myurus, <i>Deslongchamps</i> .....	130	VI, 4 a—c .....					x	x	p G.O.
pinguis, <i>Hudleston</i> .....	117	IV, 10; VII, 11 .....							x
Pontonis, <i>Hudleston</i> .....	135	VII, 1 a, b .....			x				
— var. <i>spinifera</i> .....	135	VII, 2 .....			x				
prælonga, <i>Hudleston</i> .....	126	V, 10 .....						x	
primigenia, <i>Hudleston</i> .....	137	VII, 3 .....							x
pseudo-armata, <i>Hudleston</i> .....	125	V, 8 .....		x					
cf. <i>rarispina</i> , <i>Schlumberger</i> .....	118	IV, 12 .....						p	
Roubaleti, <i>Schlumberger</i> , var. <i>Dorsetensis</i> .....	123	V, 5 a—f, 6; VII, 10 .....		x				x	
solida, <i>Lycett</i> .....	139	VII, 5, 6 .....				p			
spinigera, <i>Lycett</i> .....	138	VII, 4 .....				x			
sublævigata, <i>Hudleston</i> .....	129	VI, 3 a, b, 3' a, 3' b .....		x				x	
unicarinata, <i>Hudleston</i> .....	118	IV, 13 a—c .....		x		p			
unicornis, <i>Lycett</i> .....	119	V, 1 and ? 7 a, b .....					x		x
(? <i>Diartema</i> ) <i>varicifera</i> , <i>Hudleston</i> .....	141	II, 10, a, b; VII, 8 a, b, } 8' a, b. .... }			x				

	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midland.	Cotteswolds.	Dundry.	Dorset—Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
<b>AMBERLEYA</b>									
cf. anaglyptica [Trochus], <i>Münster</i> .....	288	XXII, 12 .....							×
biserata [Trochus], <i>Phillips</i> .....	288	XXII, 13, 14; XXIII, 1, 2 .....	×					×	
capitanea [Eucyclus], <i>Münster</i> .....	277	XXI, 12 .....	×		×				?
cygnea [Eucyclus], <i>Hudleston</i> .....	283	XXIV, 10 .....			×				
densinodosa [Eucyclus], <i>Hudleston</i> .....	282	XXII, 3, 4, 5 .....					×	×	
? Dundriensis [Turbo], <i>Tawney</i> .....	293	XXIV, 11 .....					×		
elongata [Turbo], <i>Hudleston</i> .....	292	XXIII, 8, 9 .....			×			×	
gemmata [Eucyclus], <i>Lycett</i> .....	281	XXIII, 19 .....			×				
cf. generalis [Eucyclus], <i>Münster</i> .....	287	XXIII, 3 .....					?		
goniata [Eucyclus], <i>Deslongchamps</i> .....	284	XXII, 6 (juv.) .....							×
cf. Meriani [Eucyclus], <i>Goldfuss</i> .....	283	XXIII, 17 .....		×	×				
Milleri [Turbo], <i>Wright, MS.</i> .....	290	XXIII, 5 .....						×	
Murchisoni [Eucyclus], <i>Münster</i> .....	286	XXII, 11 .....							×
Obornensis [Eucyclus], <i>Hudleston</i> .....	286	XXII, 10 .....							×
Orbignyana [Eucyclus], <i>Hudleston</i> .....	285	XXII, 7, 8 .....							×
ornata [Eucyclus], <i>Sowerby</i> .....	279	XXI, 13, 14 .....	×		×	×	×	×	
— var. spinulosa, <i>Münster</i> .....	280	XXI, 15 .....							×
— var. abbas .....	280	XXI, 16, 17, 18; XXII, 1 .....							×
— var. horrida .....	281	XXII, 2 .....							×
pagodiformis [Eucyclus], <i>Hudleston</i> .....	287	XXII, 9 .....							×
Stoddarti [Turbo], <i>Tawney</i> .....	291	XXIII, 11 .....					×		
turbinoides [Turbo], <i>Hudleston</i> .....	290	XXIII, 7 and ? 6 .....						×	
<b>APTXYIELLA</b>									
subconica, <i>Hudleston</i> .....	191	XII, 10, 11 .....					×		
<b>ATAPHRUS</b>									
Acis, d'Orbigny .....	352	XXIX, 14 .....			×		×		×
Aemon, d'Orbigny .....	351	XXIX, 11, 12, 13 .....					×		×
heliciformis, <i>Morris &amp; Lycett</i> .....	348	Not figured .....				×	×		×
Labadyei, d'Archiac .....	350	XXIX, 9, 10 .....	×		×	×	×		×
lævigatus, <i>Sowerby</i> .....	349	XXIX, 5, 6 .....	×		×	×	×		×
cf. lucidus, <i>Thorent</i> .....	348	XXVIII, 18 a, b .....			×				
obtusatus, <i>Hudleston</i> .....	350	XXIX, 7, 8 .....	×		?			×	×
<b>BOURGUETIA</b>									
striata, <i>Sowerby</i> .....	249	XIX, 8, 9 .....		×	×	×		×	Cor.
<b>BRACHYTREMA</b>									
binodosum, <i>Hudleston</i> .....	99	VII, 12 .....			×				
Pontonis, <i>Hudleston</i> .....	484	XLIII, 21 a, b .....			×				
subvaricosum, <i>Hudleston</i> .....	98	II, 9 a, b .....			×				
Wrightii, <i>Cotteau</i> , var. despecta .....	99	II, 8 a—c .....							×
<b>BULLA</b>									
Favrei, <i>Lycett</i> .....	481	XLIII, 10 .....					×		
undulata, <i>Bean</i> .....	482	XLIII, 11 a, b .....		×					×
<b>CAPULUS</b>									
ancyloides, <i>Sowerby</i> .....	459	XLII, 3 a, b .....			×				×
rugosus, <i>Sowerby</i> .....	458	XLII, 1 a, b, 2 a, b .....	×		×	×			×





	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotswolds.	Dundry.	Dorset— Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
<b>CIRRUS</b>									
<i>Calisto, d'Orbigny</i> .....	312	XXV, 1 .....			x			x	
<i>Etheridgii, Lycett</i> .....	306	XXIV, 15 .....			x				
<i>gradatus, Hudleston</i> .....	307	XXIV, 17 .....						x	
<i>Leachi, Sowerby</i> .....	308	XXV, 3, 4, 5 .....			?		x	x	
<i>nodosus, Sowerby</i> .....	313	XXV, 6 .....					x	x	
<i>pyramidalis, Tawney</i> .....	311	XXIV, 18, 19, 20 .....			x				
<i>varicosus, Hudleston</i> .....	313	XXV, 2 .....			x				
<b>CLOUGHTONIA</b>									
<i>cincta, Phillips</i> .....	247	XIX, 7 a, b .....	x	x	x				
<b>CROSSOSTOMA</b>									
<i>cf. Prattii, Morris &amp; Lycett</i> .....	346	XXVIII, 17 a, b .....			x			?	
<b>CRYPTAULAX</b>									
<i>contorta, Deslongchamps</i> .....	185	XI, 15 a—c .....				x			x
<i>papillosa, Deslongchamps</i> .....	183	XI, 13 .....							x
<i>scobina, Deslongchamps</i> .....	181	XI, 10 .....	x		x		x		
<i>tortilis, Hébert &amp; Deslongchamps</i> .....	182	XI, 12 a—c .....				x		x	Cal.
<i>cf. undulata, Quenst.</i> .....	184	XI, 14 .....						x	
<b>CYLINDRITES</b>									
<i>attenuatus, Lycett</i> .....	479	XLIII, 15 a, b .....			x				
<i>brevispira, Hudleston</i> .....	479	XLIII, 17, 18 .....			x				
<i>cylindricus, Morris &amp; Lycett</i> .....	481	XLIII, 16 a, b .....				x			G. O.
<i>mammillaris, Lycett</i> .....	480	Not figured .....			x	x			
<i>tabulatus, Lycett</i> .....	479	XLIII, 14 a, b .....			x				
— <i>var. Weldonis</i> .....	480	XLIII, 13 a, b .....			x				
<i>turriculatus, Lycett</i> .....	478	XLIII, 12 .....			x				
<b>DELPHINULA</b>									
<i>alta-acanthica, Hudleston</i> .....	363	XXX, 9 .....			x				
— <i>var. depressa</i> .....	363	XXX, 10 .....			x				
<i>alta-bicarinata, Hudleston</i> .....	362	XXX, 8 .....			x				
<i>angulata, Hudleston</i> .....	367	XXX, 15, 16 .....	x		x			x	
<i>Buckmanni</i> [Turbo], <i>Morris &amp; Lycett</i> ..	364	XXX, 11 .....			x				
<i>granata</i> [Turbo], <i>Hudleston</i> .....	368	XXX, 17 .....	x		?	?			
<i>quaterno-cingillata, Lycett</i> .....	490	Not figured .....			x				
<i>Santonis</i> [Turbo], <i>Hudleston</i> .....	369	XXX, 18, 18 a .....			x				
<i>Shaleri</i> [Turbo], <i>Tawney</i> .....	365	XXX, 12 .....					x	x	
— <i>var. pulchrior</i> .....	366	XXX, 14 .....						x	
<b>DISCOHELIX</b>									
<i>Cotswoldiæ, Lycett</i> .....	316	XXV, 7 .....			x				
<i>spinosus, Wright MS.</i> .....	317	XXV, 8 .....						x	
<b>EMARGINULA</b>									
<i>granulata, Lycett</i> .....	453	Not figured .....			x				
<i>Leckhamptonensis, Lycett</i> .....	452	XLI, 11 a, b .....			x				
<i>Lindonensis, Hudleston</i> .....	452	XLI, 14 a, b, and ? 13 a, b .....			x				
<i>scalaris, Sowerby</i> .....	451	XLI, 12 a, b .....			x				



	Page.	Plates and Figures.	Lias.	Yorkshire.		East Midlands.	Cotteswolds.		Dundry.	Dorset—Somerset.		Higher beds.
				L.	U.		L.	U.		L.	U.	
<b>EUCYCLOIDEA</b> ( <i>Purpurina</i> , sect. 2)												
bianor, <i>d'Orbigny</i> .....	95	II, 5 <i>a—h</i> .....									×	
carino-crenata, <i>Lycett</i> .....	97	II, 7 <i>a, b</i> .....					×					
<b>EUSPIRA</b> ?												
Species, "subcoronata" .....	270	XXI, 2 .....				×						
<b>EXELISSA</b>												
Normaniana, <i>d'Orbigny</i> .....	180	XI, 9 .....								×		
pulchra, <i>Lycett</i> .....	179	XI, 7 .....				×						G. O.
strangulata, <i>d'Archiac</i> .....	178											G. O.
— var. <i>ovalis</i> .....	178	XI, 6 .....				×						
— var. <i>pisolitica</i> .....	178	XI, 5 <i>a, b</i> .....					×					
Weldonis, <i>Hudleston</i> .....	179	XI, 8 <i>a, b</i> .....				×	×					
<b>FIBULA</b>												
angustivoluta, <i>Hudleston</i> .....	174	XI, 1 .....				×						
canina, <i>Hudleston</i> .....	175	XI, 2 <i>a, b</i> .....		×								
? <i>velox</i> , <i>Hudleston</i> .....	486	XLIV, 7 <i>a, b</i> .....					×					
<b>FOSSARUS</b>												
ooliticus [ <i>Couthouya</i> ], <i>Hudleston</i> .....	492	XLII, 17 .....								×		
<b>HAMUSINA</b>												
Damesi, <i>Gemmellaro</i> .....	304	XXIV, 12 .....								×		
Oppelensis, <i>Lycett</i> .....	305	XXIV, 13, 14 .....					×			×		
<b>LITTORINA</b>												
ædilis, <i>Münster</i> (fide <i>Tawney</i> ) .....	298	XXIV, 1 and ? 2 .....					×		×			
Dorsetensis, <i>Hudleston</i> .....	299	XXIV, 3, 4, 5 .....					×			×		
pisolitica [? <i>Trochus</i> ], <i>Hudleston</i> .....	300	XXIV, 9 .....					×					
Phillipsii, <i>Morris &amp; Lycett</i> .....	296	XXIII, 16 .....		?	×	×	?				×	
polytimeta [ <i>Tectarius</i> ], <i>Hudleston</i> .....	295	XXIII, 12, 13 .....					?			×		
prætor [ <i>Echinella</i> ], <i>Goldfuss</i> .....	294	XXIV, 8 .....								×		
recteplanata [? <i>Trochus</i> ], <i>Tawney</i> .....	300	XXIV, 6, 7 .....					×		×			
cf. <i>sulcata</i> , <i>Hébert &amp; Deslongchamps</i> .....	297	XXIII, 15 .....									×	
triarmata [? <i>Trochus</i> ], <i>Heb. &amp; Desl.</i> .....	301	Not figured .....								?		
Weldonis, <i>Hudleston</i> .....	297	XXIII, 18 .....					×					
<b>MALAPTERA</b>												
Bentleyi, <i>Morris &amp; Lycett</i> .....	101	III, 1 <i>a—c</i> .....					×					
— var. <i>neglecta</i> .....	102	III, 2 .....					×					
<b>MONODONTA</b>												
Lyelli, <i>d'Archiac</i> .....	357	XXX, 1, 2 .....					×		?			G. O.
— var. <i>humilis</i> .....	357	XXX, 3 .....					×					
pisolitica, <i>Hudleston</i> .....	356	XXIX, 17 and ? 18 .....						×				
<b>NATICA</b>												
adducta, <i>Phillips</i> .....	257	XX, 3 .....		×	×	×	×					
— var. <i>globata</i> .....	259	XX, 5, 6 .....					×			×		
— var. <i>Oppelensis</i> , <i>Lycett</i> .....	258	XX, 2 .....					×					
Bajocensis, <i>d'Orbigny</i> .....	263	XX, 13 <i>a, b</i> .....						×			×	

	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotteswolds.	Dundry.	Dorset— Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
NATICA									
canaliculata, <i>Morris &amp; Lycett</i> .....	265	XX, 16 .....	x		x				
cincta, <i>Phillips</i> .....	266	XX, 17; XXI, 3, 4 .....	x		x	x			
Dundriensis, <i>Tawney</i> .....	262	XX, 11 <i>a—c</i> .....					?	x	x
Hulliana, <i>Lycett</i> .....	262	XX, 12 .....			x				x
cf. Lorieri, <i>d'Orbigny</i> .....	259	XX, 8 .....			x	x		x	
— var. canina .....	260	XX, 9 <i>a, b</i> and ? fig. 1 .....	x		?				
— var. proxima .....	260	XX, 7 .....	x						
cf. Michelini, <i>d'Archiac</i> .....	269	XX, 18 <i>a, b</i> .....			x				
? protracta [ <i>Euspira</i> ], <i>Hudleston</i> .....	265	XX, 15 .....						x	
punctura, <i>Bean</i> (pars) .....	264	XX, 14 .....	x	x					
NERINÆA									
altivoluta [ <i>Nerinæa</i> ], <i>Witchell</i> .....	203	XIII, 10 <i>a—d</i> .....			x	x			
attenuata [ <i>Nerinæa</i> ], <i>Witchell</i> .....	201	XIII, 6 <i>a</i> .....				x			
bacillus [ <i>Ptygmatis</i> ], <i>d'Orbigny</i> .....	217	XV, 5 <i>a, b</i> , 6 <i>a—c</i> , 7 <i>a</i> ; } XVI, 12 .....			x	x	x		G. O.
brevivoluta [ <i>Ptygmatis</i> ], <i>Hudleston</i> .....	225	XVI, 9 <i>a, b</i> and ? 10 .....				x			
campana [ <i>Ptygmatis</i> ], <i>Hudleston</i> .....	214	XV, 2 <i>a, b</i> .....			x				
cingenda [? <i>Ptygmatis</i> ], <i>Phillips</i> .....	210	XIV, 13 <i>a—f</i> , 14; XLIV, 8 .....	x		x	x			
conoidea [ <i>Nerinella</i> ], <i>Hudleston</i> .....	197	XII, 14 .....			x				
consobrina [ <i>Ptygmatis</i> ], <i>Witchell</i> .....	221	Not figured .....			x				
Cotteswoldiæ [ <i>Ptygmatis</i> ], <i>Lycett</i> .....	222	XVI, 3 <i>a—d</i> .....			x	x			
— var. conica, <i>Witchell</i> .....	223	XVI, 4 <i>a, b</i> and ? 4 <i>c, d</i> .....			x	x			
deducta [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	202	XIII, 8 .....			x				
cf. elegantula [ <i>Nerinæa</i> ], <i>d'Orbigny</i> .....	210	XIV, 12 .....			x				G. O.
Eudesii [ <i>Nerinæa</i> ], <i>Morris &amp; Lycett</i> .....	205	XIV, 2, 2 <i>a</i> .....			x				G. O.
expansa [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	201	XIII, 6 <i>b</i> .....			x				
gracilis [ <i>Nerinella</i> ], <i>Lycett</i> .....	196	XII, 12, 13 <i>a, b</i> .....			?	x			
Guisi [ <i>Ptygmatis</i> ], <i>Witchell</i> .....	213	XV, 1 <i>a—c</i> .....				x			
Hudlestoniana [ <i>Nerinæa</i> ], <i>Witchell</i> .....	204	XIV, 1 .....			x				
Jonesii [ <i>Ptygmatis</i> ], <i>Lycett</i> .....	218	XV, 9 <i>a—c</i> .....			?	x			
Longfordensis [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	200	XIII, 5 .....			x	x			
neglecta [ <i>Nerinella</i> ], <i>Hudleston</i> .....	487	XLIV, 4 <i>a, b</i> .....			x				
oolitica [ <i>Nerinæa</i> ], <i>Witchell</i> .....	199	XIII, 4 <i>a—d</i> , 6, 7 .....			x				
Oppelensis [ <i>Ptygmatis</i> ], <i>Lycett</i> .....	219	XV, 11 <i>a—e</i> .....			?	x			
parva [ <i>Nerinæa</i> ], <i>Witchell</i> .....	199	XIII, 3 .....			x				
pisolitica [ <i>Ptygmatis</i> ], <i>Witchell</i> .....	215	XV, 3 <i>a—c</i> and XVI, 7 .....			x				
producta [ <i>Ptygmatis</i> ], <i>Witchell</i> .....	220	XV, 10 <i>a—c</i> .....			x				
pseudocylindrica [ <i>Nerinæa</i> ], <i>d'Orbigny</i> .....	203	XIII, 9 and ? 11 .....			x				G. O.
cf. pseudopunctata [ <i>Nerinæa</i> ], <i>Cossmann</i> .....	209	XIV, 10 <i>a—c</i> .....			x				G. O.
Santonis [ <i>Ptygmatis</i> ], <i>Hudleston</i> .....	224	XVI, 8 <i>a—c</i> .....			x				
cf. Stricklandi [ <i>Nerinæa</i> ], <i>Morris &amp; Lycett</i> .....	208	XIV, 9 .....			x				G. O.
Stroudiensis [ <i>Ptygmatis</i> ], <i>Witchell</i> .....	222	XVI, 2 <i>a, b</i> .....			x				
subbrevioluta [ <i>Ptygmatis</i> ], <i>Hudleston</i> .....	226	XVI, 11 .....			x				
subcingenda [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	212	XIV, 16 <i>a, b</i> .....			x				
subglabra [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	207	XIV, 8 .....			x				
velox [ <i>Ptygmatis</i> ], <i>Witchell</i> .....	221	XVI, 1 .....			x				
Weldonis [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	206	XIV, 3 <i>a, b</i> ; 4; ? 5 .....			x				
xenos [ <i>Ptygmatis</i> ], <i>Hudleston</i> .....	216	XV, 4 <i>a, b</i> .....			x				
zonophora [ <i>Nerinæa</i> ], <i>Hudleston</i> .....	207	XIV, 7 .....			x				

	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotteswolds.	Dundry.	Dorset—Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
NERITA									
costulata, Deshayes.....	332	XL, 6 a, b and ? XXVIII, 6 a, b }	x	x		x			
pseudocostata, d'Orbigny .....	333	XXVIII, 7, 8, 9.....	x			x			
subrugosa, Hudleston.....	334	XL, 7 a, b; 8.....		x	x	x			
tumidula [Neridomus], Phillips .....	335	XXVIII, 12 a, b .....	x		x	x			
transverse species [Neridomus] .....	336	XL, 9 a, b .....	x			x			
NERITOPSIS									
Bajocensis, d'Orbigny.....	340	XXVII, 9 a—c.....							x
cf. decussata, Münster .....	342	XXVIII, 5 a—c.....			x				Cor.
cf. Hebertana, d'Orbigny .....	343	XXVIII, 3 a—c.....	x			?		x	
incisa, Hudleston.....	342	XXVIII, 2.....			x	x			
Philea, d'Orbigny .....	341	XXVII, 11 a—c .....		x				x	
cf. sulcosa, d'Archiac .....	344	XXVIII, 4.....				x			G. O.
varicosa, Morris & Lycett .....	341	XXVIII, 1 a—c.....				x			? G. O.
ONUSTUS									
acuminatus, Hudleston .....	328	XXVII, 3.....						x	
Heberti, Laube .....	329	XXVII, 6 a, b; 7.....						?	
heliacus, d'Orbigny, var. opalina .....	329	XXVII, 4 a, b .....	x					x	
cf. lamellosus, d'Orbigny .....	328	XXVII, 5 a, b .....						x	
ornatissimus, d'Orbigny.....	330	XXVII, 8 a, b .....				?			x
pileus, Lycett .....	490	Not figured .....				x			
pyramidatus, Phillips.....	326	XXVII, 1, 2.....	x		x			x	
PALUDINA									
Langtonensis, Hudleston .....	488	XLIV, 1 a, b .....					x		
PATELLA									
cf. cingulata [? Scurria], Münster .....	461	XLII, 5 a—c.....					x		G. O.
fenestræ, Hudleston.....	463	XLII, 9 a, b .....					x		
inornata [Scurria], Lycett.....	460	XLII, 4 a, b .....			x	x			
nana [Scurria], Sowerby.....	462	XLII, 6 a, b .....			x				G. O.
nitida [Scurria], Deslongchamps .....	461	XLII, 7 a, b .....				x			G. O.
retifera, Lycett .....	463	Not figured .....				x			
Römeri, Morris & Lycett .....	463	XLII, 8 a, b .....			x				G. O.
"PHASIANELLA"									
conoidea, Hudleston .....	254	XIX, 14 a.....		?	x				
elegans, Morris & Lycett .....	252	XIX, 11 a, b; 12.....				x			G. O.
latiuscula, Morris & Lycett .....	251	XIX, 10 a, ? 10 b.....			x	x			?
Leymeriei, d'Arch., var. Lindonensis .....	253	XXI, 5 .....			x				G. O.
Pontonis, Lycett .....	253	XIX, 13 .....			x				? G. O.
cf. subumbilicata, d'Archiac .....	255	XIX, 15 .....			x				G. O.
PILEOLUS									
lævis, G. B. Sowerby .....	338	XXVIII, 15 a—c .....			x	?			G. O.
plicatus, G. B. Sowerby .....	337	XXVIII, 13 a, b; 14 a—c; 16.....			x	x			G. O.



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				L.	U.		L.	U.		L.	U.	
PLEUROTOMARIA <sup>1</sup>												
<i>abbreviata</i> , Sowerby	401	XXXIII, 8, 9							x		x	
<i>Actæa</i> , d'Orbigny	431	XXXVII, 8							x		x	
<i>actinomphala</i> , Deslongchamps	433	XXXVII, 7a, b; XXXVIII, 1-5							x	x		
<i>Agatha</i> , d'Orbigny	402	XXXIII, 12 a, b; XXXIV, 6									x	
— var. <i>Sandersii</i> , Tawney	403	XXXIV, 7							x			
<i>Ajax</i> [Leptomaria], d'Orbigny	412	XXXV, 8, 8 a, b; 9, 9 a				x						
<i>Alcyone</i> , d'Orbigny	409	XXXV, 4, 4 a, b									x	
<i>Alimena</i> , d'Orbigny	419	Not figured									x	
<i>Allica</i> , d'Orbigny	422	XXXVI, 5, 5 a							x		x	
<i>amata</i> , d'Orbigny	418	XLIV, 11 a—c									x	
<i>Amyntas</i> [? Leptomaria], d'Orbigny	415	XXXV, 12							x	x		
cf. <i>araneosa</i> , Deslongchamps	438	XXXIX, 2 a, b	x	x		x						
<i>armata</i> , Münster	427	XXXVII, 5									x	
<i>Athulia</i> , d'Orbigny	409	XXXIV, 12									?	
<i>Baugieri</i> , d'Orbigny	435	XXXIX, 4 a—c; var. 5 a—c								x		
<i>Bessina</i> , d'Orbigny	406	XXXIV, 4, 5									x	
<i>bicingulata</i> , Hudleston	398	XXXIII, 3								x		
<i>circumsulcata</i> , d'Orbigny	404	XXXIII, 10, 11; XXXIV, 3									x	
<i>distinguenda</i> , Tawney	407	XXXIV, 10; XXXV, 1							x		x	
<i>Dundriensis</i> , Tawney	407	XXXIV, 11							x			
<i>elongata</i> , Sowerby	399											
— var. <i>angusta</i>	400	XXXIII, 4								x		
— var. near to <i>conoidea</i> , Deshayes	400	XXXIII, 6									x	
— type form = Pl. <i>Pictaviensis</i> , d'Orbigny	400	XXXIII, 7								x		
— var. <i>Ebrayana</i> , d'Orbigny	401	Not figured								x		
— var. <i>turrita</i> , Deslongchamps	401	XXXIV, 8									x	
<i>fasciata</i> , Sowerby	416	XXXVI, 3				x	x	?	x	x	x	
<i>granulata</i> , Sowerby	440	XXXIX, 10 a—c; XL, 1, 1 a							x		x	
<i>mirabilis</i> , Deslongchamps	437	XXXIX, 7 a—c	x							x		
<i>mopsa</i> , d'Orbigny	436	XXXIX, 6 a—c	x							x		
<i>monticulus</i> [Leptomaria], Deslongchamps	413	Not figured								x		
<i>monticuloides</i> , Hudleston	413	XXXV, 10, 10 a								x		
<i>Obornensis</i> , Hudleston	404	XXXIV, 9										x
<i>ornata</i> , Sowerby	429	XXXVII, 3 a—c								x		x
<i>ornata-depressa</i> , Hudl. (? <i>carinata</i> , Sow.)	431	XXXIX, 3 a—c					x			x	x	
<i>oxytera</i> , Hudleston	433	XXXVII, 6										x
<i>Palæmon</i> , d'Orbigny	443	XL, 3 a—c								x		x
<i>paucistriata</i> , d'Orbigny	425	XXXVII, 1								x		x
<i>phylax</i> , Hudleston	441	XL, 4 a—c										x
<i>phyospira</i> , d'Orbigny	420	Not figured								x		x
<i>plicopunctata</i> , Deslongchamps	442	XL, 2 a—c								x		x
<i>Proteus</i> , Deslongchamps	426	XXXVII, 2										x
<i>punctata</i> , Sowerby	396	XXXIII, 1, 2								x	x	
cf. <i>Sauzeana</i> , d'Orbigny	428	Not figured								x		x
<i>scrobinula</i> , Deslongchamps	408	XXXV, 3, 3 a; ? 2										x
<i>subaraneosa</i> , Hudleston	437	XXXIX, 1 a, b										x
<i>subdecorata</i> , Münster	421	XXXVI, 10	x			x				x	x	
<i>subfasciata</i> , d'Orbigny	420	XLIV, 10										x

<sup>1</sup> It is probable that more species of *Pleurotomaria* occur in the Cotteswold District than those quoted in the Table. But as the specimens are found chiefly in the condition of casts or in bad preservation the specific characters are often uncertain. Thus we may expect to find *Pl. elongata* and other common species.



	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotteswolds.	Dundry.	Dorset—Somerset.	Higher beds.
			L.	U.		L.	U.	L.	U.
<b>PLEUROTOMARIA</b>									
subglabra, <i>Hudleston</i> .....	405	XXXIV, 1, 2 .....							×
subplatyspira, <i>d'Orbigny</i> .....	416	XXXVI, 1 .....							×
subreticulata, <i>d'Orbigny</i> .....	422	XXXVI, 6, 6 a; ? 7 .....			?		×		×
sulcata [ <i>Leptomaria</i> ], <i>Sowerby</i> .....	410	XXXV, 6, 6 a, b; 7, 7 a, b .....				×	×	×	
sulcata-Humphriesiana [ <i>Leptomaria</i> ], <i>Hudleston</i> .....	414	XXXV, 11 .....							×
Stoddarti, <i>Tawney</i> .....	418	XXXVI, 2 .....					×		
textilis, <i>Deslongchamps</i> .....	424	XXXVI, 8 .....					?		×
including Pl. scalaris, <i>Deslongch.</i>		XXXVI, 9 .....							×
transilis, <i>d'Orbigny</i> .....	419	XXXVI, 4, 4 a .....							×
trapeza, <i>Hudleston</i> .....	444	XL, 5 a, b .....							×
tuberculosa, <i>DeFrance</i> .....	428	XXXVII, 4 a, b .....							×
Yeovilersis, <i>Tawney</i> .....	439	XXXIX, 8 a, b, c .....					×	×	
— var. rugosior .....	439	XXXIX, 9 a, b .....							×
<b>PSEUDALARIA</b>									
Etheridgii, <i>Tawney</i> .....	189	XII, 6 a—c, 7 .....						×	
— var. granosa .....	190	XII, 8 .....						×	
jugosa, <i>Bean</i> .....	190	XII, 9 .....	×						
<b>PSEUDOMELANTA</b>									
Astonensis, <i>Hudleston</i> .....	245	XVIII, 8 a, b .....			×		×		
bicarinata, <i>Wright, MS.</i> .....	238	XVIII, 3 a—c .....						×	
Burtonensis, <i>Hudleston</i> .....	246	XIX, 5 .....							×
coarctata, <i>Deslongchamps</i> .....	242	XVIII, 9 a—c; XIX, 1 a, b .....					×		×
heterocycla, <i>Eugène Deslongchamps</i> .....	239	XVIII, 4 a, b; (variety) 4 c .....					×		
lævigata, <i>Morris &amp; Lycett</i> .....	244	XXI, 6 .....		×					? G. O.
lineata, <i>Sowerby</i> .....	241	XVIII, 7 a, b .....					×		×
Lonsdalei, <i>Morris &amp; Lycett</i> .....	243	XIX, 2 .....		×					G. O.
procera, <i>Deslongchamps</i> .....	237	XVII, 9; XVIII, 1, 2; XXI, 1 ? .....	×		×	×		×	
simplex, <i>Morris &amp; Lycett</i> .....	244	XIX, 4 .....				×			? G. O.
<b>PUNCTURELLA</b>									
acuta, <i>Deslongchamps</i> .....	457	XLI, 19 a—c .....				×			G. O.
<b>PURPURINA</b>									
aspera, <i>Hudleston</i> .....	91	I, 11 a—e .....						×	
bellona, <i>d'Orbigny</i> .....	88	I, 5 a—f .....							×
— var. pagoda .....	89	I, 7 a—c .....							×
calcar, <i>Hudleston</i> .....	91	II, 1 a, b .....						×	
cancellata, <i>Hudleston</i> .....	87	I, 3 a, b .....						?	
curta, <i>Hudleston</i> .....	90	I, 6 a, b .....							×
elaborata, <i>Lycett</i> .....	85	I, 1 a—g .....		×	×	×	×	×	G. O.
inflata, <i>Tawney</i> .....	92	II, 2 a—f .....					×	×	
parcicosta, <i>Hudleston</i> .....	90	I, 10 a, b .....						?	
rotunda, <i>Hudleston</i> .....	93	II, 3 a—d .....						×	
cf. <i>Sowerbyi</i> , <i>Waagen</i> .....	93	Not figured .....						×	
tabulata, <i>Hudleston</i> .....	94	II, 4 a—c .....						×	
varicosa, <i>Lycett</i> .....	483	Not figured .....				×			
<b>PURPUROIDEA</b>									
species .....	483	XLIV, 9 .....			×				

	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotteswolds.	Dundry.	Dorset— Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
<b>RIMULA</b>									
<i>alta</i> , <i>Lycett</i> .....	455	XLI, 18 <i>a, b</i> .....			×				
<i>clathrata</i> , <i>Sowerby</i> .....	454	XLI, 15 <i>a, b</i> .....			×				G. O.
<i>oolitica</i> , <i>Hudleston</i> .....	456	Not figured .....			?	×			
<i>rugosa</i> , <i>Hudleston</i> .....	454	XLI, 16 <i>a, b</i> .....			×				
<i>subtricarinata</i> , <i>Hudleston</i> .....	455	XLI, 17 <i>a, b</i> .....			×				
<b>RISSOINA</b>									
<i>gymnoides</i> , <i>Hudleston</i> .....	273	XXI, 11 .....			×				
<i>obliquata</i> , <i>Sowerby</i> .....	272	XXI, 7 .....			×				G. O.
— var. <i>parvicostata</i> .....	272	XXI, 8 .....		×					
— var. <i>inflata</i> .....	272	XXI, 9 .....			×				
<i>obtusa</i> , <i>Lycett</i> .....	273	XXI, 10 <i>a, b</i> .....			×				
<b>SOLARIUM</b>									
<i>diadema</i> , <i>Lycett</i> , <i>MS.</i> .....	323	XXVI, 10 .....			×				
<i>pisoliticum</i> , <i>Hudleston</i> .....	322	XXVI, 6—8 .....			×				
<i>polygonoides</i> , <i>Hudleston</i> .....	323	XXVI, 9 .....				×			
<i>subvaricosum</i> , <i>Hudleston</i> .....	324	XXVI, 11, 12 .....				×			
<b>SPINIGERA</b>									
<i>crassa</i> , <i>Hudleston</i> .....	107	III, 7 .....						×	
<i>didactyla</i> , <i>Hudleston</i> .....	106	III, 6 <i>a—g</i> .....					×		
<i>longispina</i> , <i>Deslongchamps</i> .....	104	III, 4 <i>a—c</i> .....					×	×	
<i>recurva</i> , <i>Hudleston</i> .....	105	III, 5 <i>a—h</i> .....						×	
<i>trinitatis</i> , <i>Tawney</i> .....	103	III, 3 <i>a—e</i> .....					×	×	
<b>STRAPAROLLUS</b>									
<i>cf. altus</i> , <i>d'Orbigny</i> .....	321	XXVI, 5 .....					×		
<i>Dundriensis</i> , <i>Tawney</i> .....	319	XXVI, 2 .....					×	×	
<i>exsertus</i> , <i>Hudleston</i> .....	320	XXVI, 3, 4 .....						×	
<i>pulehrior</i> , <i>Hudleston</i> .....	318	XXV, 9 .....						×	
<i>cf. tuberculosus</i> , <i>Thorent</i> .....	317	XXVI, 1 .....				?		×	
<b>TROCHOTOMA</b>									
<i>affinis</i> , <i>Deslongchamps</i> .....	447	XLI, 4 .....				×		×	
<i>calix</i> , <i>Phillips</i> .....	445	XLI, 1 <i>a, b</i> ; 6 <i>a—c</i> ; 7 .....	×		?	×			
<i>depressiuscula</i> , <i>Lycett</i> .....	448	XLI, 10 .....				×			
<i>funata</i> , <i>Lycett</i> .....	450	XLI, 5 <i>a, b</i> .....			×				
<i>gradus</i> , <i>Deslongchamps</i> .....	447	XLI, 2, 3 .....	×				×		
<i>Lindonensis</i> , <i>Hudleston</i> .....	449	XLI, 8, 8 <i>a</i> ; 9 .....			×				
<b>TROCHUS</b>									
<i>angulatus</i> , <i>Sowerby</i> .....	374	XXXI, 11 .....				×		×	
<i>biarmatus</i> , <i>Münster</i> .....	386	XXXII, 14 .....				×		×	Cal.
? <i>bicingendus</i> , <i>Lycett</i> .....	389	XXXI, 15 .....				×			
<i>cf. Bixa</i> , <i>d'Orbigny</i> .....	388	XXXII, 17; and ? XXXI, 16 .....			×		×		G. O.
<i>Burtonensis</i> , <i>Lycett</i> .....	385	XXXII, 12 .....				×	×		
<i>dimidiatus</i> , <i>Sowerby</i> (? <i>Zetes, d'Orb.</i> ) .....	379	XXXI, 8 .....	?		×	×	×	×	
<i>Dunkeri</i> , <i>Morris &amp; Lycett</i> , var. <i>Weldonis</i> .....	383	XXXII, 10 .....			×				G. O.
<i>duplicatus</i> , <i>Sowerby</i> .....	373	XXXI, 10 .....				×		×	
<i>Duryanus</i> , <i>d'Orbigny</i> .....	375	XXXI, 12 .....						×	
? <i>Leckenbyi</i> , <i>Morris &amp; Lycett</i> .....	386	XXXII, 13 .....		×					

	Page.	Plates and Figures.	Lias.	Yorkshire.	East Midlands.	Cotteswolds.	Dundry.	Dorset—Somerset.	Higher beds.
			L.	U.	L.	U.	L.	U.	
<b>TROCHUS</b>									
<i>marga</i> , <i>Hudleston</i> .....	387	XXXII, 15 .....						×	
<i>monilitectus</i> , <i>Phillips</i> .....	380	XXXII, 3 <i>a</i> , <i>b</i> .....		×	×	?		?	
<i>Niortensis</i> , <i>d'Orbigny</i> .....	388	Not figured .....	×			?	×		
<i>rupestris</i> , <i>Hudleston</i> .....	371	XXXI, 2 .....						×	
<i>Sandersii</i> , <i>Tawney</i> .....	370	XXXI, 1 .....					×	×	
<i>spiratus</i> , <i>d'Archiac</i> .....	378	XXXI, 6, 7 .....			×				G. O.
<i>squamiger</i> , <i>Morris &amp; Lycett</i> .....	382	XXXII, 8 .....				×			G. O.
<i>squamosior</i> , <i>Hudleston</i> .....	382	XXXII, 5 .....			×				
<i>subduplicatus</i> , <i>d'Orbigny</i> .....	375	XXXI, 13, 14 .....	×		×		×		
— var. <i>abbas</i> .....	377	XXXII, 1 .....					×		
— var. <i>plicata</i> , <i>Goldfuss</i> ..	376	XXXII, 2 .....					×		
<i>subluciensis</i> , <i>Hudleston</i> .....	381	XXXII, 6, 7 .....			×	×	×		
<i>substrigosus</i> , <i>Hudleston</i> .....	384	XXXII, 11, and ? 4 .....						×	
<i>sybilla</i> , <i>Hudleston</i> .....	371	XXXI, 3 .....					×		
<i>vicinus</i> , <i>Hudleston</i> .....	383	XXXII, 9 .....			×	×			
<i>Winwoodi</i> , <i>Tawney</i> .....	372	XXXI, 4, 5 .....					×		
<i>Zetes</i> , <i>d'Orbigny</i> , fide <i>Tawney</i> ..	379	XXXI, 9 .....					×		
<b>"TROCHUS"</b>									
<i>atrochus</i> , <i>Hudleston</i> .....	390	XXIX, 15, 16 .....						×	
<b>TURBO</b>									
<i>Davoustii</i> [ <i>Delphinula</i> ], <i>d'Orbigny</i> ..	360	XXX, 7 .....					×		×
— var. <i>Lindonensis</i> .....	361	XXX, 6 .....			×	×			
<i>Hamptonensis</i> , <i>Morris &amp; Lycett</i> ..	359	XXIX, 19, 20 .....	×		×	×	×	×	G. O.
<i>laevigatus</i> , <i>Phillips</i> .....	354	XXIX, 1 .....	×		?				
? <i>Lindecolinus</i> , <i>Hudleston</i> .....	355	XXIX, 3, 4 .....			×				
<b>TURRITELLA</b>									
<i>abbas</i> [ <i>Mathilda</i> ], <i>Hudleston</i> .....	230	XVII, 2 <i>a—c</i> .....				×		×	
cf. <i>binaria</i> [? <i>Mathilda</i> ], <i>Hébert &amp; Desl.</i>	234	XVII, 7 .....						×	Cal.
<i>Dorsetensis</i> , <i>Hudleston</i> .....	228	XVII, 1 <i>a—c</i> .....				×		×	
<i>opalina</i> [ <i>Mathilda</i> ], <i>Quenstedt</i> .....	231	XVII, 3 <i>a</i> , <i>b</i> .....						×	
— var. <i>canina</i> .....	232	XVII, 4 .....	×					?	
<i>quadrivittata</i> [ <i>Mathilda</i> ], <i>Phillips</i> ..	233	XVII, 6 .....	×		×			×	
<i>strangulata</i> [ <i>Mathilda</i> ], <i>Hudleston</i> ..	233	XVII, 5 .....						×	
cf. <i>Schlumbergeri</i> , <i>Eug. Deslongchamps</i>	229	Not figured .....						?	
<b>VALVATA</b>									
<i>comes</i> , <i>Hudleston</i> .....	489	XLIII, 27; XLIV, 2 <i>a</i> , <i>b</i> ..				×			



## TABLE II.

### INDEX OF SYNONYMS, ETC.

*Actæon glaber*, Phillips, vide ACTÆONINA.

— *humeralis*, Phillips, vide ACTÆONINA.

— *pullus* (H. and D.), Morris and Lycett, vide ACTÆONINA.

— *Sedgwici* (Phil.), *auctorum*, vide ACTÆONINA.

*Actæonina Davoustana*, d'Orbigny, vide *Actæonina tumidula*, Lycett.

— *Deslongchampsii*, d'Orbigny, vide *Actæonina gigantea*, Deslongchamps.

— *tumidula*, Morris and Lycett, vide *Actæonina tumidula*, Lycett.

*Alaria Etheridgii*, Tawney, vide PSEUDALARIA.

*Ampullina Michelini* (d'Arch.), Cossmann, vide NATICA.

*Auricula Sedgwici*, Phillips, vide ACTÆONINA.

*Cassis Esparcyensis*, d'Archiac, vide ACTÆONINA (*Trochactæonina*).

*Cerithium* (?) *caninum*, Hudleston, vide FIBULA.

— *clypeus*, Hudleston, ? *Cerithium clypeatum*, Witchell.

— (*Kilvertia*) *Comptonense*, Hudleston, vide *Exelissa Weldonis*, Hudleston.

— *contortum*, Deslongchamps, vide CRYPTAULAX.

— *Normanianum*, d'Orbigny, vide EXELISSA.

— *opis*, d'Orbigny, vide *Cerithium comma*, Münster.

— *papillosum*, Deslongchamps, vide CRYPTAULAX.

— *quadrivittatum*, d'Orbigny, vide TURRITELLA.

— *scobina*, Deslongchamps, vide CRYPTAULAX.

— *strangulatum*, d'Archiac, vide EXELISSA.

— *tortile*, Hébert and Deslongchamps, vide CRYPTAULAX.

— *turris*, Hudleston, vide *Cerithium cæruleum*, Hudleston and Wilson.

— *undulatum*, Quenstedt, vide CRYPTAULAX.

— *varicosum* (Desl.), Moore, vide *Cryptaulax scobina*, Deslongchamps.

*Ceritella sculpta*, Lycett, vide ACTÆON (*Tornatellæa*).

*Chemnitzia coarctata*, d'Orbigny, vide *Pseudomelania coarctata*, Deslongchamps.

— *elegans*, Lycett, vide *Pseudomelania coarctata*, Deslongchamps.

— *gracilis*, Lycett, vide NEBINÆA (*Nerinella*).

— *hetocycla*, Eug., Deslongchamps, vide PSEUDOMELANIA.

— *lineata* (Sow.), Hudleston, vide *Pseudomelania procera*, Deslongchamps.

— *lineata-procera*, var. *Scarburgensis*, Hudleston, vide *Pseudomelania Lonsdalei*, Morris and Lycett.

— *Lonsdalei*, Morris and Lycett, vide PSEUDOMELANIA.

— *Normaniana*, d'Orbigny, vide *Pseudomelania lineata*, Sowerby.

— *Scarburgensis*, Morris and Lycett, vide *Pseudomelania Lonsdalei*, Morris and Lycett.

— *simplex*, Morris and Lycett, vide PSEUDOMELANIA.

— *vetusta-major*, Hudleston, vide CERITHIUM.

— *vetusta*, var. *seminuda*, Hudleston, vide CERITHIUM.

*Cirrus carinatus*, Sowerby, cf. *Pleurotomaria ornata-depressa*, Hudleston.

- ? *Crossostoma heliciformis*, Morris and Lycett, vide ATAPHRUS.  
*Cylindrites gradus*, Lycett, vide *Cylindrites attenuatus*, Lycett.  
*Diartema varicifera*, Hudleston, vide ALABIA.  
*Ditremaria affinis*, d'Orbigny, vide *Trochotoma affinis*, Deslongchamps.  
*Emarginula alta*, Lycett, vide RIMULA.  
— *clathrata*, Sowerby, vide RIMULA.  
*Eucyclus goniatus*, Deslongchamps, vide AMBERLEYA.  
— *pinguis*, Deslongchamps, vide AMBERLEYA.  
*Eulima lævigata*, Morris and Lycett, vide PSEUDOMELANIA.  
*Euomphalus tuberculosus*, Thorent, vide STRAPAROLLUS.  
*Euspira Bajocensis* (d'Orb.), Tawney, vide NATICA.  
— *canaliculata*, Morris and Lycett, vide NATICA.  
— *Dundriensis*, Tawney, vide NATICA.  
*Fissurella acuta*, Deslongchamps, vide PUNCTURELLA.  
— *Brodiei*, Lycett, vide *Patella retifera*, Lycett.  
*Fusus* ? *carino-crenatus*, Lycett, vide PURPURINA (*Eucycloidea*).  
*Hamusina Calisto* (d'Orb.), Cossmann, vide CIRRUS.  
*Kilvertia pulchra*, Lycett, vide EXELISSA.  
*Littorina biarmata* (Münst.), Tawney, vide TROCHUS.  
— *nana*, Lycett, vide *Ataphrus Acmon*, d'Orbigny.  
— *ornata* (Sow.), Morris, vide AMBERLEYA.  
— *punctura*, Bean, vide NATICA.  
*Mathilda abbas*, Hudleston, vide TURBITELLA.  
*Melania abbreviata*, Deslongchamps, vide CERITHIUM.  
— *coarctata*, Deslongchamps, vide PSEUDOMELANIA.  
— *lineata*, Sowerby, vide PSEUDOMELANIA.  
— *Normaniana*, d'Orbigny, vide *Pseudomelania lineata*, Sowerby.  
— *procera*, Deslongchamps, vide PSEUDOMELANIA.  
— *scalariformis*, Deslongchamps (pars), vide *Cerithium comma*, Münster.  
— — Deslongchamps (pars), vide *Cerithium circe*, d'Orbigny.  
— — Deslongchamps, vide CERITHIUM.  
— *striata*, Sowerby, vide BOURGUETIA.  
— *turris*, Deslongchamps, vide *Melania coarctata*, Deslongchamps.  
— *undulata*, Deslongchamps, vide CERITHIUM.  
*Monodonta Acmon* (d'Orb.), Tawney, vide ATAPHRUS.  
— *adducta*, Phil. var. *canina*, vide *Natica Lorieri*, d'Orb. var. *canina*.  
— *heliciformis* (Morris and Lycett), Lycett, vide ATAPHRUS.  
— *Labadyei* (d'Arch.), Morris and Lycett, vide ATAPHRUS.  
— *lævigata* (Sow.), Lycett, Morris, Tawney, vide ATAPHRUS.  
*Natica* (*Euspira*) ? *cincta* (Phil.), Morris and Lycett, vide CLOUGHTONIA.  
— *decussata*, Münster, vide NERITOPSIS.  
— *Leckhamptonensis*, Lycett, vide *Natica cincta*, Phillips.  
— *Oppelensis*, Lycett, vide *Natica adducta*, Phillips, var. *Oppelensis*, Lycett.  
— *proxima*, Hudleston, vide *Natica Lorieri*, d'Orbigny, var. *proxima*.  
— *subumbilicata*, d'Archiac, vide "PHASIANELLA."  
— *tumidula*, Phillips, vide NERITA (*Neridomus*).  
*Naticella decussata* (Goldf.), Lycett, vide NERITOPSIS.  
*Neridomus*, vide NERITA.

- Nerinxæ conica*, Witchell, vide *Nerinxæ (Ptygmatis) Cotteswoldiæ*, Lycett, var. *conica*.  
 — *cylindrica*, Deslongchamps, vide *Nerinxæ pseudo-cylindrica*, d'Orbigny.  
 — *punctata* (Voltz.), Morris and Lycett, vide *Nerinxæ pseudopunctata*, Cossmann.  
*Nerinella*, vide *NERINÆA*.  
*Nerita costata*, Sowerby, vide *Nerita costulata*, Deshayes.  
*Nerita costata* (Sow.), Phillips, vide *Nerita pseudocostata*, d'Orbigny.  
 — *lævigata*, (Sowerby), vide *ATAPHRUS*.  
 — *minuta* (Sow.), Cossmann, vide *Nerita costulata*, Deshayes.  
 — — Sowerby, var. *tumidula* (Phil.), Hudleston, vide *Nerita tumidula*, Phillips.  
 ? — *sulcosa*, d'Archiac, vide *NERITOPSIS*.  
*Neritopsis* (? *Turbo*) *lævigata* (Phil.), Hudleston, vide *Turbo lævigatus*, Phillips.  
*Patella ancyloides*, Sowerby, vide *CAPULUS*.  
 — *costulata*, Münster, ? vide *Pileolus plicatus*, G. B. Sowerby.  
 — *mammillaris*, Münster, vide *Pileolus lævis*, G. B. Sowerby.  
 — *rugosa*, Sowerby, vide *CAPULUS*.  
 — *Tessonii*, Deslongchamps, vide *Capulus rugosus*, Sowerby, syn. or var. *Tessonii*, Deslongchamps.  
*Phasianella acutiusscula*, Lycett, vide "*Phasianella*" *conica*, Morris and Lycett.  
 — *cincta*, Phillips, vide *CLOUGHTONIA*.  
 — *Sæmanni*, Oppel, vide *Bourguetia striata*, Sowerby.  
 — *striata* (Sow.), Morris and Lycett, vide *BOURGUETIA*.  
 — *turbiniformis*, Lycett, vide *Natica Bajocensis*, d'Orbigny.  
*Pleurotomaria Debuchii*, var. *exsertiuscula*, Deslongchamps, vide *Pl. mopsa*, d'Orbigny.  
 — *Defrancii*, Hudleston and Wilson, vide *Pl. plicopunctata*, Deslongchamps.  
 — *dentata*, Deslongchamps, vide *Pl. armata*, Münster.  
 — *fasciata*, var. *crenata*, Deslongchamps, vide *Pl. subfasciata*, d'Orbigny.  
 — — var. *platyspira*, Deslongchamps, vide *Pl. subplatyspira*, d'Orbigny.  
 — — var. *phyospira*, Deslongchamps, vide *Pl. phyospira*, d'Orbigny.  
 — *granulata*, Sowerby, vars. *reticulata* and *cælata*, Deslongchamps, vide *Pl. granulata*, Sowerby.  
 — — var. *plicopunctata*, Deslongchamps, vide *Pl. plicopunctata*, Deslongchamps.  
 — — (Deslong.), d'Orbigny, vide *Pl. plicopunctata*, Deslongchamps.  
 — — vars. *lentiformis* and *lævigata*, Deslongchamps, vide *Pl. Palæmon*, d'Orbigny.  
 — *gyrocycla*, var. *transilis*, Deslongchamps, vide *Pl. transilis*, d'Orbigny.  
 — *gyroplata*, var. *æquistriata*, Deslongchamps, vide *Pl. Alimena*, d'Orbigny.  
 — *mutabilis*, Deslongchamps, var. *patula*, vide *Pl. Bessina*, d'Orbigny.  
 — — var. *circumsulcata*, Deslongchamps, vide *Pl. circumsulcata*, d'Orbigny.  
 — — var. *cælata*, Deslongchamps, vide *Pl. Agatha*, d'Orbigny.  
 — — Deslongchamps, vars. *elongata*, *mutica*, and *ambigua*, vide *Pl. elongata*, Sowerby.  
 — *ornata*, Defrance, vide *Pl. plicopunctata*, Deslongchamps.  
 — — var. *sulcifera*, Deslongchamps, vide *Pl. tuberculosa*, Defrance.  
 — *pallium* (Sow.), Morris and Tawney, vide *Pl. ornata*, Sowerby.  
 — *Pictaviensis*, d'Orbigny, vide *Pl. elongata*, Sowerby, type form.  
 — *Proteus*, var. *paucistriata*, Deslongchamps, vide *Pl. paucistriata*, d'Orbigny.  
 — *reticulata*, Deslongchamps, vide *Pl. subreticulata*, d'Orbigny.  
 — *Sandersii*, Tawney, vide *Pl. Agatha*, d'Orbigny, var. *Sandersii*, Tawney.  
 — *scalaris*, Deslongchamps, syn. or var. cf. *Pl. textilis*, Deslongchamps.  
*Pterocera Bentleyi*, Morris and Lycett, vide *MALAPTERA*.  
 — *Doublieri*, d'Orbigny, vide *ALARIA*.



*Pterocera Lorieri*, d'Orbigny, vide ALARIA.

— *Phillipsii*, d'Orbigny, vide *Alaria hamus*, Deslongchamps, var. *Phillipsii*, d'Orbigny.

*Ptygmatis*, vide NERINÆA.

*Purpurina Bathis*, d'Orbigny, vide *Amberleya ornata*, Sowerby, var. *spinulosa*, Münster.

— *ornata*, d'Orbigny, vide *Amberleya Orbignyana*, Hudleston.

*Ranella longispina*, Deslongchamps, vide SPINIGERA.

*Rimula Blotii*, auctorum, vide *Rimula oolitica*, Hudleston.

*Rissoa obliquata*, Sowerby, vide RISSOINA.

*Rissoina duplicata*, d'Orbigny, vide *Rissoina obliquata*, Sowerby.

*Rostellaria composita* (Sow.), Phillips, vide *Alaria hamus*, Deslongchamps, var.

— *gracilis*, Lycett, vide *Alaria Lorieri*, d'Orbigny, var. *gracilis*, Lycett.

— *hamus*, Deslongchamps, vide ALARIA.

— *myurus*, Deslongchamps, vide ALARIA.

— *solida*, Lycett, vide ALARIA.

— *spinigera*, Lycett, vide ALARIA.

— *unicornis*, Lycett, vide ALARIA.

*Rotella lucida*, Thorent, vide ATAPHRUS.

*Rotella macrostoma*, Stoliczka, cf. *Crossostoma Prattii*, Morris and Lycett.

*Solarium calix*, Phillips, vide TROCHOTOMA.

— *Cotswoldiæ*, Lycett, vide DISCHOHELIX.

*Teinostoma Neumayri*, Gemmellaro, cf. *Crossostoma Prattii*, Morris and Lycett.

*Terebra vetusta*, Phillips, vide CERITHIUM.

*Tornatella gigantea*, Deslongchamps, vide ACTÆONINA.

*Trochotoma carinata*, Lycett, vide *Trochotoma affinis*, Deslongchamps.

*Trochus abbreviatus*, Sowerby, vide PLEUROTOMARIA.

— *Acis*, d'Orbigny, vide ATAPHRUS.

— *Aemon*, d'Orbigny, vide ATAPHRUS.

— *anaglypticus*, Münster, cf. AMBERLEYA.

— *Belus*, d'Orbigny, vide *Ataphrus lævigatus*, Sowerby, var.

— *bisertus*, Phillips, vide AMBERLEYA.

— *bitorquatus*, Hébert and Deslongchamps?, vide *Trochus biarmatus*, Münster.

— *cingillato-serratus*, Lycett, doubtful, but cf. *Trochus Winwoodi*, Tawney.

— *concurvus*, Sowerby, vide *Trochus angulatus*, Sowerby.

— *elongatus*, Sowerby, vide PLEUROTOMARIA.

— *fasciatus*, Sowerby, vide PLEUROTOMARIA.

— *granulatus*, Sowerby, vide PLEUROTOMARIA.

— *Ibbetsoni* (Morris and Lycett), Tawney, vide *Ataphrus Acis*, d'Orbigny.

— *jugosus*, Bean, vide PSEUDALARIA.

— *Labadyei*, d'Archiac, vide ATAPHRUS.

— *ornatissimus*, d'Orbigny, vide ONUSTUS.

— *ornatus*, Sowerby, vide PLEUROTOMARIA.

— *pallium*, Farey, in Sowerby, vide *Pleurotomaria ornata*, Sowerby.

— *pileus*, Lycett, vide ONUSTUS.

— *punctatus*, Sowerby, vide PLEUROTOMARIA.

— *pyramidatus*, Phillips, vide ONUSTUS.

— *sulcatus*, Sowerby, vide PLEUROTOMARIA (*Leptomaria*).

— *triarmatus*, Hébert and Deslongchamps, vide ? LITTORINA.

*Turbo ædilis* (Münst.), Tawney, vide LITTORINA.

*Turbo bianor*, d'Orbigny, vide PURPURINA (*Eucycloidea*).

- *Calisto*, d'Orbigny, vide CIRRUS.
- *capitaneus*, Münster, vide AMBERLEYA.
- *Cheltensis*, Lycett, vide *Littorina* (*Turbo*) *ædilis*, Münster, fide Tawney.
- *Dundriensis*, Tawney, vide AMBERLEYA or EUCYCLOIDEA.
- *elaboratus*, Lycett, vide PURPURINA.
- *Etheridgii*, Lycett, vide CIRRUS.
- *gemmatus*, Lycett, vide AMBERLEYA.
- (*Delphinula*) *granatus* (Bean), Hudleston, vide DELPHINULA.
- *Labadyei* (d'Arch.), d'Orbigny, vide ATAPHRUS.
- (*Monodonta*) *lævigatus* (Sow.), Hudleston, vide ATAPHRUS.
- — — Sow., var. *bellulata*, Bean?, vide *Ataphrus Labadyei*, d'Archiac, var.
- *Lyelli*, d'Orbigny, vide MONODONTA.
- *Meriani*, Goldfuss, vide AMBERLEYA.
- *Murchisoni*, Münst., vide AMBERLEYA.
- *Oppelensis*, Lycett, vide HAMUSINA.
- *ornatus*, Sowerby, vide AMBERLEYA.
- *Phillipsii*, Morris and Lycett, vide LITTORINA.
- *plicatus*, Goldfuss, vide *Trochus subduplicatus*, d'Orbigny, var. *plicata*, Goldfuss.
- *prætor*, Goldfuss, vide LITTORINA.
- *Shaleri*, Tawney, vide DELPHINULA.
- *spinulosus*, Münster, vide *Amberleya ornata*, Sowerby, var. *spinulosa*, Münster.
- *Stoddarti*, Tawney, vide AMBERLEYA (*Turbo*).
- *subduplicatus*, d'Orbigny, vide TROCHUS.
- *varicosus*, Lycett, vide PURPURINA.

*Turritella cingenda*, Phillips, vide NERINÆA.

- — — Sowerby, vide CERITHINELLA.
- *muricata*, Sowerby, vide CERITHIUM.
- *quadrilineata*, Römer, vide CERITHIUM.
- *Roissyi*, d'Archiac, vide CERITHIUM.
- *undulata* (Quenst.), Hébert and Deslongchamps, vide CRYPTAULAX.

### TABLE III.

List of Gasteropoda from the Inferior Oolite, partially described by Lycett, but not figured, which are not accepted as species in this Monograph.

*Chemnitzia nitida*, Lycett. No evidence.

*Cylindrites bulbiformis*, Lycett. No evidence.

*Eulima parvula*, Lycett. The apical condition of some species of *Pseudomelania*.

*Fusus obliquatus*, Lycett. No evidence.

*Natica Gomondii*, Lycett. No evidence.

*Nerita cassidiformis*, Lycett. A fragment in the Brodie Collection, genus doubtful; not sufficient material to constitute a species.

— *lineata*, Lycett. No evidence.

*Phasianella subangulata*, Lycett. No evidence.

*Pleurotomaria funata*, Lycett. No evidence. } Possibly synonyms of some of Sowerby's species.

— *laevigata*, Lycett. No evidence. }

*Rimula minutissima*, Lycett. No evidence.

*Rostellaria simplex*, Lycett. No evidence.

*Scalaria pygmæa*, Lycett. A fragment apparently of *Rissoina*.

*Trochus alternans*, Lycett. No evidence.

— *infundibuliformis*, Lycett. No evidence.



## TABLE IV.

The following list includes species quoted by previous authors from the Inferior Oolite, which are not tabulated in this Monograph.

<i>Actæonina parvula</i> , Römer.	<i>Nerinxæ punctata</i> , Voltz.
<i>Alaria subpunctata</i> , Goldfuss.	— <i>triplicata</i> , Bronn.
<i>Ceritella acuta</i> , Morris and Lycett.	— <i>Voltzii</i> , Deslongchamps.
<i>Cerithium Roissyi</i> , d'Archiac.	<i>Nerita pulla</i> , Römer.
<i>Chemnitzia Wetherellii</i> , Morris and Lycett.	<i>Onustus Burtonensis</i> , Lycett.
<i>Cylindrites acutus</i> , Sowerby.	<i>Phasianella conica</i> , Morris and Lycett (= <i>Ph.</i>
— <i>brevis</i> ? Morris and Lycett.	<i>acutiuscula</i> , M. and L.).
<i>Delphinula alta</i> , Morris and Lycett.	— <i>parvula</i> , Morris and Lycett.
— <i>funata</i> , Goldfuss.	— <i>tumidula</i> , Morris and Lycett.
<i>Emarginula Blotii</i> , Deslongchamps.	<i>Pleurotomaria clathrata</i> , Morris and Lycett.
— <i>planicostulata</i> , Deslongchamps.	<i>Rimula tricarinata</i> , Sowerby.
<i>Fusus</i> ? <i>carinatus</i> , Römer.	<i>Trochotoma extensa</i> , Morris and Lycett.
<i>Natica formosa</i> , Morris and Lycett.	— <i>obtusa</i> , Morris and Lycett.
— <i>macrostoma</i> , Römer.	— <i>tabulata</i> , Morris and Lycett.
— ? <i>neritoidea</i> , Morris and Lycett.	<i>Trochus bigugatus</i> , ? Quenstedt.
— <i>Stricklandi</i> , Morris and Lycett.	<i>Turbo depauperatus</i> , Lycett.
— <i>Verneuli</i> , d'Archiac.	— <i>princeps</i> , Römer.
<i>Nerinxæ Bruntrutana</i> , d'Archiac.	

Of the above species, some, such as *Cerithium Roissyi* and other Bathonian forms, most probably occur in the higher beds, and especially in the *Paludina*-bed at Langton Bridge, which has more of a Great Oolite than an Inferior Oolite fauna. The same may also be said of *Natica Stricklandi* (quoted by Witchell from the *Clypeus*-grit), and possibly other Bathonian species of *Natica*. Again, we may regard *Nerita pulla* as a general term for any small *Nerita* (*Neridomus*), which in the Inferior Oolite may possibly be covered by *Nerita tumidula*. *Delphinula alta*, as it occurs in the Lincolnshire Limestone, has been split up into two species, each of which differs more or less from the Great Oolite form.

On the other hand, it seems highly probable that some of the names on the list, such as *Natica macrostoma*, *Turbo princeps*, and several more, are the result of incorrect identification.

## TABLE V.

The following species of Gasteropoda are quoted from the Bajocian (Oolitic facies) of the region lying to the west of the Central Plateau in France.<sup>1</sup> It is interesting to observe how many of our Inferior Oolite Nerinaeas have been identified in that region.

<i>Actæonina</i> , species.	<i>Pseudomelania Astonensis</i> , Hudleston.
<i>Cylindrites exiguus</i> , Lycett.	— <i>lineata</i> , d'Orbigny.
— <i>excavatus</i> , Morris and Lycett.	<i>Purpuroidea</i> , cf. <i>nodulata</i> , Young and Bird.
— <i>bullatus</i> , Morris and Lycett.	<i>Pleurotomaria</i> , species.
<i>Cerithium</i> , species.	<i>Rissoina</i> , species.
<i>Exelissa</i> , species.	<i>Natica Bajocensis</i> , d'Orbigny.
<i>Ceritella</i> , species.	<i>Nerita</i> , species.
<i>Brachytrema subvaricosum</i> , Hudleston.	<i>Neritopsis sulcosa</i> , d'Archiac.
<i>Nerinea Oppelensis</i> , Lycett, very common.	<i>Pileolus</i> , cf. <i>radiatus</i> , d'Orbigny.
— <i>Cotteswoldiæ</i> , Lycett, very common.	<i>Phasianella acutiuscula</i> , Morris and Lycett
— <i>deducta</i> , Hudleston.	(= <i>Ph. conica</i> , M. and L.).
— <i>oolitica</i> , Witchell.	<i>Turbo</i> , cf. <i>Calypso</i> , d'Orbigny.
— <i>expansa</i> , Hudleston, fairly common.	<i>Amberleya</i> , species.
— <i>campana</i> , Hudleston.	<i>Trochus</i> , species.
— <i>acicula</i> , d'Archiac.	<i>Delphinula</i> , species.
— <i>subbrevivoluta</i> , Hudleston.	<i>Discohelix</i> , species.
— <i>pisolitica</i> , Witchell.	<i>Trochotoma tabulata</i> , Morris and Lycett.
— <i>deducta</i> , Hudleston.	<i>Ditremaria</i> , species.
— <i>subbruntrutana</i> , d'Orbigny.	<i>Fissurella</i> , species.
— <i>elegantula</i> , d'Orbigny.	<i>Emarginula</i> , species.
— species.	<i>Scurria squamula</i> , Deslongchamps.
<i>Aptyxiella</i> , species.	— <i>nitida</i> , Deslongchamps.
<i>Turritella (Mathilda) opalina</i> , Hudleston.	<i>Patella (Helcion) rugosa</i> , Sowerby.
<i>Pseudomelania Niortensis</i> , d'Orbigny, common.	

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<sup>1</sup> 'Bulletin des services de la Carte Géologique de France' (No. 50), vol. viii (1896-7), p. 118, Dr. Glangeaud.

# TABLE VI.

## ERRATA.

### TEXT.

Page 32, line 15, *for* rich-shell *read* rich shell-bed.

„ 39, lines 34 and 40, *for* Broadwinsor *read* Broadwindsor.

„ 45, line 14, *for* vol. xv *read* vol. xvi.

„ 72, „ 26, *for* *limæforma*-group *read* *limæforme*-group.

„ 75, „ 12, *for* Plant-beds *read* Plant-bed.

„ 77, „ 27, *for* Linnæan *read* Linnean.

„ 79, „ 1, *for* Petrifacta *read* Petrefacta.

„ „ 10, *delete* '53, '55; and *for* Mollusca *read* Gasteropoda.

„ 80, between lines 28 and 29 *insert* MOORE. Abnormal Secondary Deposits. *Quart. Journ. Geol. Soc.*, vol. xxiii, p. 449.

„ 81, „ 13 and 14 *insert* TATE. New Liassic Fossils. *Geol. Mag.*, 1875, p. 203.

„ 82, line 1 *for* Northamptonshire *read* Northamptonshire.

„ 83, „ 24, *for* vol. xviii *read* vol. xiii.

„ 85, „ 10, *for* Pl. II *read* Pl. XI.

„ 101, „ 14, *for* CHENOPUS *read* PTEROCERA.

„ 116, „ 32, *for* Millipore *read* Millepore.

„ 119, „ 29, *for* 1853 *read* 1850.

„ „ between lines 29 and 30 *insert* "1850. ROSTELLARIA UNICORNIS, *Lycett.* Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 419."

„ 122, lines 7 and 8, *for* DUNDREYENSIS *read* DUNDRIENSIS.

„ 132, line 20, *for* 6 a' *read* 6' a.

„ 135, „ 1, *for* 1853 *read* 1850.

„ 135, between lines 1 and 2 *insert* "1850. ROSTELLARIA GRACILIS, *Lycett.* Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 119."

„ 138, line 14, *for* 1853 *read* 1850.

„ „ between lines 14 and 15 *insert* "1850. ROSTELLARIA SPINIGERA, *Lycett.* Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 119.

„ 139, line 13, *for* 1853 *read* 1850; and *for* Plate IV *read* Plate VII.

„ „ between lines 13 and 14 *insert* "1850. ROSTELLARIA SOLIDA, *Lycett.* Ann. Mag. Nat. Hist., 2nd ser., vol. vi, p. 119."

„ „ line 14, *for* ALARIA *read* ROSTELLARIA.

„ 146, „ 12, *for* vol. i *read* part i.

„ „ 13, *for* 135 *read* 102.

„ 147, „ 8, *for* *trilineatum* *read* *trilineata*.

„ „ 11, *for* p. 11 *read* p. 115.

„ 148, „ 27, *delete* vol. i; and *for* 152 *read* 123.

„ 154, „ 3 *insert* vol. vii after "Norm."

„ 160, „ 1, *delete* sp. nov.

„ 161, „ 1, *delete* sp. nov.



Page 161, line 10, *for* Minchinhamptom *read* -ton.

„ 180, „ 11, *for* Normanniana *read* Normaniana.

„ „ „ 12, *for* Normannianum *read* Normanianum.

„ 181, „ 7, *for* Peristone *read* Peristome.

„ „ „ 27, *for* 418 *read* 419.

„ 202, „ 3, *for* fig. 6 *read* figs. 6 c and 7.

„ 203, „ 32, *for* posterior *read* anterior.

„ 205, „ 7, *for* pl. viii *read* pl. vii.

„ 226, „ 24, *for* subtruntrutana *read* subbruntrutana.

„ 231, „ 11, *for* fig. 13 *read* fig. 15.

„ 236, „ 4, *for* p. 812 *read* p. 810.

„ „ „ 16, *for* Pietet *read* Pictet.

„ 238, „ 22, *for* Buckholdt *read* Buckholt.

„ 240, „ 9, *for* Deslongchamp's *read* Deslongchamps'.

„ 241, lines 30 and 34, *for* Normanniana *read* Normaniana.

„ 247, line 25, *for* note p. 152, 1829, 1st edit., *read* p. 123, 1835, 2nd edit.

„ 261, „ 24, *for* Gasteropoden *read* Gastropoden : and *for* Brannen *read* Braunen.

„ 266, „ 6, *for* subcaniculata *read* subcanaliculata.

„ 272, „ 5, *for* RISSOINA *read* RISSOA.

„ „ „ 6, *for* — *read* RISSOINA.

„ 275, heading, *for* RISSOINA *read* AMBERLEYA.

„ 336, line 4, *for* Pea-grit of Crickley *read* Oolite-marl, Swifts' Hill.

„ 369, „ 2, *for* " Base-bed *read* " Base-bed."

„ 389, „ 15, *for* columela *read* columella.

„ 390, beginning of line 26, *delete* the.

„ 394, line 12, *for* inner *read* outer.

#### EXPLANATION OF PLATES.

Plate II, figs. 6 a, 6 b, *for* fusiforme *read* fusiformis.

Plate IV, fig. 12, *for* Whidborne collection *read* Woodwardian Museum.

Plate XI, fig. 9, *for* Normanniana *read* Normaniana.

Plate XIII, line 12, *for* fig. 6 *read* fig. 6 c.

Plate XVI, fig. 7. This should be represented as  $\times 1\frac{1}{2}$ .

Plate XXVIII, figs. 11 a—c, *for* Pea-grit, Crickley, *read* Oolite-marl, Swifts' Hill.

Plate XXX, fig. 14, *for* pulchior *read* pulchrrior.

#### POSTSCRIPT.

IN addition to the species described and figured in the foregoing Monograph, there are several others in my own collection which I have not ventured to bring forward, in most cases because of their imperfect condition. This is notably the case with regard to some specimens obtained in 1887 from the Yeovil sands on the coast, most probably from the *Dumortieria*-beds and other horizons of the *Jurensis*-zone.



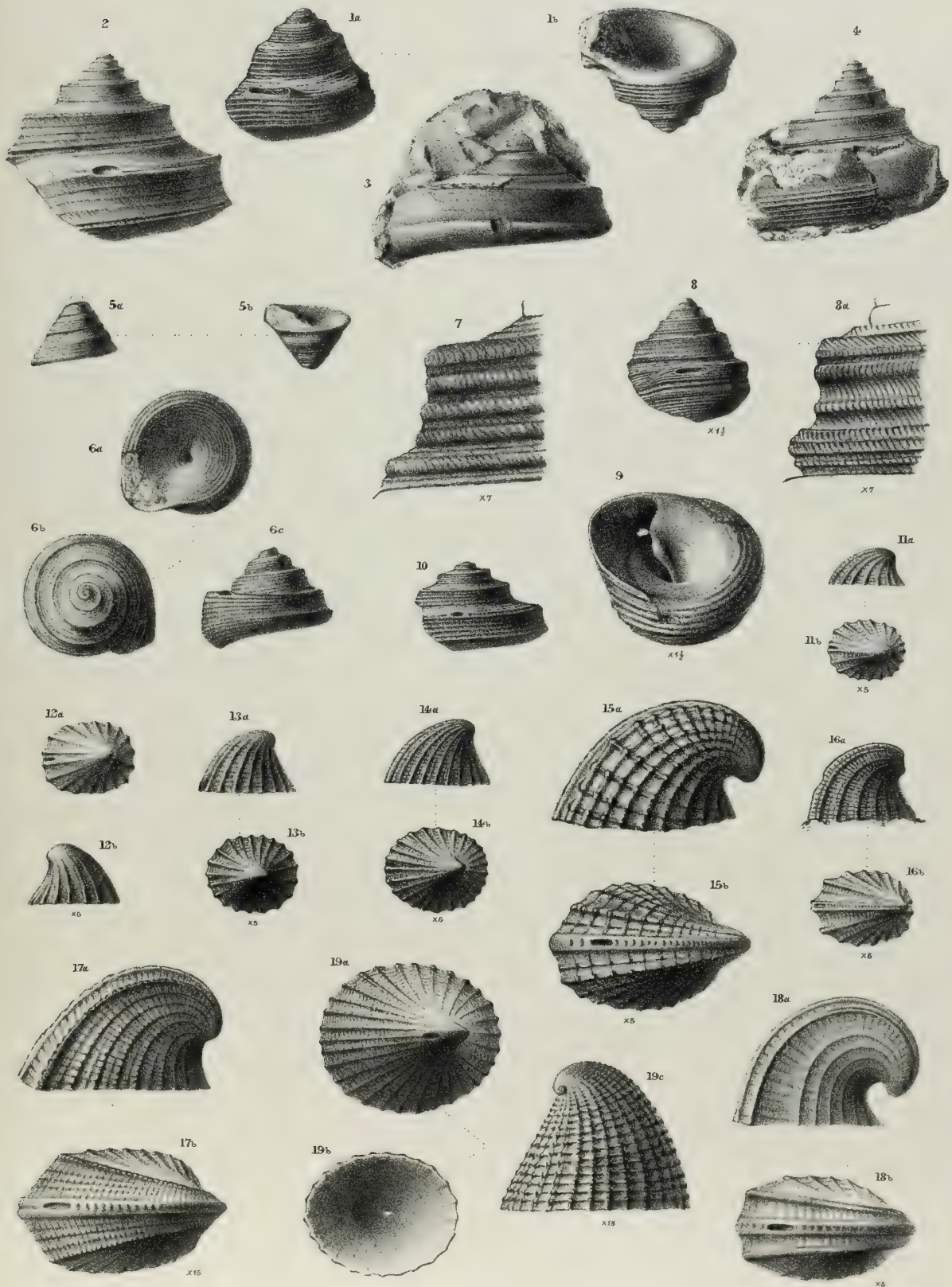
## PLATE XLI.

N.B.—A few figures of *Trochotoma* in this Plate are drawn from photographs. All specimens are from my Collection unless otherwise stated, and the same applies to the remainder of the Plates.

FIG.

- 1 a, 1 b. *Trochotoma calix*, Phillips. Variety from the Cotteswolds, Oolite-marl horizon, Nailsworth Hill. Back and base; natural size. (Page 445.)
2. *T. gradus*, Deslongchamps. A composite figure based on two specimens from the *Murchisonæ*-zone, Coker. Back; natural size. (Page 447.)
3. The same. Cast in matrix, Coker.
4. *T. affinis*, Deslongchamps (= *T. carinata*, Lycett). Stoford. Whidborne Collection. Back; natural size. (Page 447.)
- 5 a, 5 b. *T. funata*, Lycett. Pea-grit, Nailsworth Hill. Back and front; natural size. (Page 450.)
- 6 a—c. *T. calix*, Phillips. The Dogger, Blue Wyke. York Museum. Base, apical and back; natural size. (Page 445.)
7. The same. Portion of another specimen from the Dogger; magnified.
8. *T. Lindonensis*, sp. nov. Base-bed, Lincoln (*Murchisonæ*-zone). Back  $\times 1\frac{1}{2}$ .  
8 a, portion  $\times 7$ . (Page 449.)
9. The same. Basal aspect of a larger specimen from the same place  $\times 1\frac{1}{2}$ .
10. *T. depressiuscula*, Lycett. *Parkinsoni*-zone, Midford. Back; natural size. (Page 448.)
- 11 a, 11 b. *Emarginula Leckhamptonensis*, Lycett. Pea-grit, Leckhampton. Side and apical  $\times 5$ . (Page 452.)
- 12 a, 12 b. *E. scalaris*, Sowerby. (Worn specimen.) Lincolnshire Limestone, Spittlegate quarries. Apical and side  $\times 5$ . (Page 451.)
- 13 a, 13 b. *Emarginula*, species or variety. Lincolnshire Limestone, Stoke Lodge. Apical and side  $\times 5$ . (Page 453.)
- 14 a, 14 b. *E. Lindonensis*, sp. nov. Base-bed, Lincoln. Side and apical  $\times 5$ . (Page 452.)
- 15 a, 15 b. *Rimula clathrata*, Sowerby. (Lincolnshire Limestone variety.) Stoke Lodge. Apical and side  $\times 5$ . (Page 454.)
- 16 a, 16 b. *R. rugosa*, sp. nov. Base-bed, Lincoln. Side and apical  $\times 5$ . (Page 454.)
- 17 a, 17 b. *R. subtricarinata*, sp. nov. Pea-grit, Leckhampton. Side and apical  $\times 15$ . (Page 455.)
- 18 a, 18 b. *R. alta*, Lycett. Inferior Oolite of the Cotteswolds. Jermyn Street Museum. Side and apical  $\times 5$ . (Page 455.)
- 19 a—c. *Puncturella* cf. *acuta*, Deslongchamps. Pea-grit, Leckhampton. Three aspects  $\times 15$ . (Page 457.)









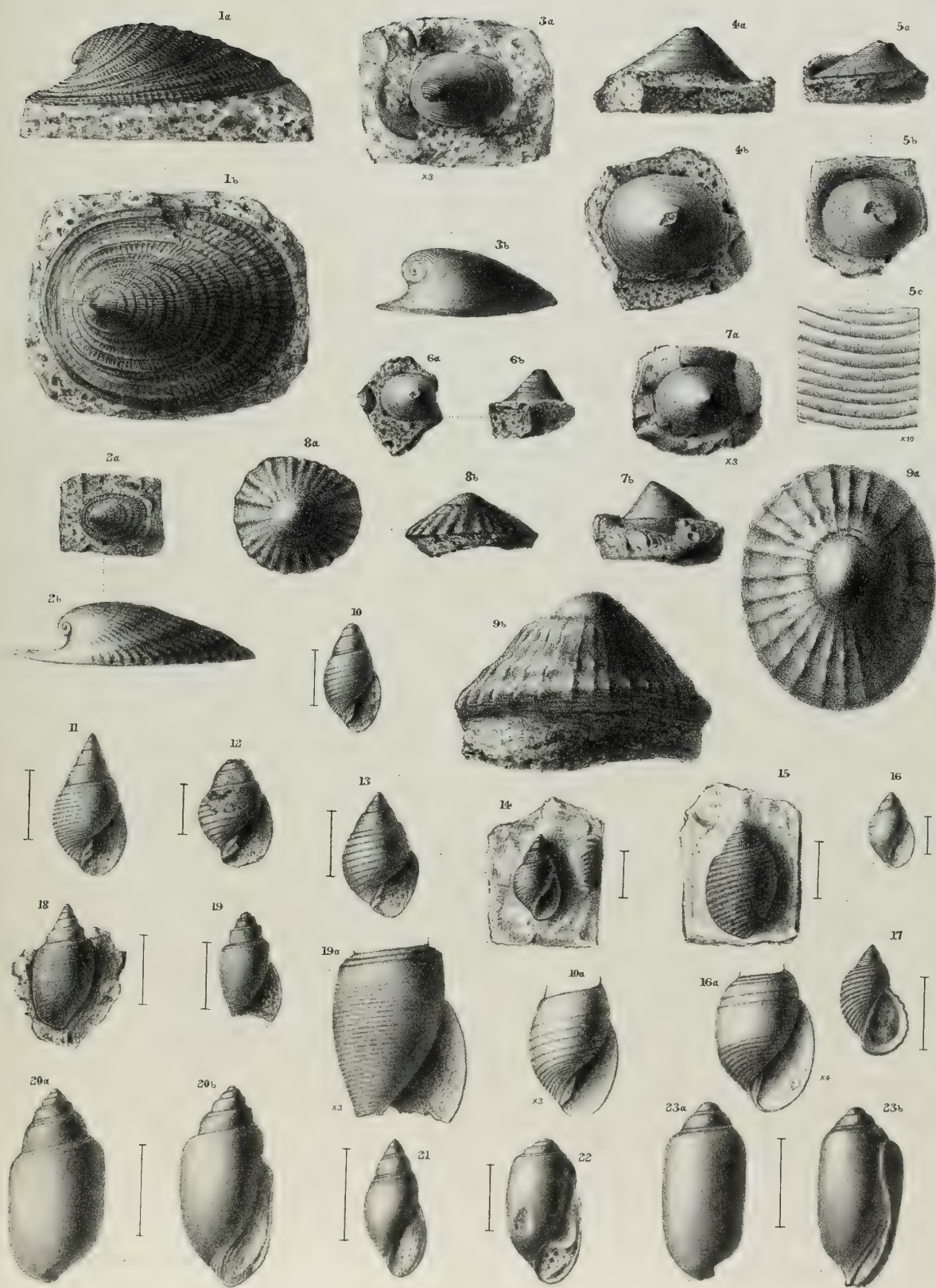
## PLATE XLII.

N.B.—About two-thirds of the figures are drawn from photographs.

FIG.

- 1 *a*, 1 *b*. *Capulus rugosus*, Sowerby. Lincolnshire Limestone, Weldon. Side and apical; natural size. (Page 458.)
- 2 *a*. The same. Lincolnshire Limestone, Stoke Lodge. Apical; natural size. Fig. 2 *b*, side view  $\times 4$ . (Scale of enlargement omitted on the plate.)
- 3 *a*. *C. ancylroides*, Sowerby. Lincolnshire Limestone, Stoke Lodge. Apical  $\times 3$ . Fig. 3 *b*, side view  $\times 5$ . (Scale of enlargement omitted on the plate.) (Page 459.)
- 4 *a*, 4 *b*. *Patella* (? *Scurria*) *inornata*, Lycett. Base of Lower Freestones, Leckhampton. Side and apical; natural size. (Page 460.)
- 5 *a*, 5 *b*. *P.* (? *Scurria*) cf. *cingulata*, Münster. Inferior Oolite, Rollwright Heath. Jermyn Street Museum. Side and apical; natural size. Fig. 5 *c*, portion enlarged to show the concentric lines. (Page 461.)
- 6 *a*, 6 *b*. *P.* (? *Scurria*) *nana*, Sowerby (variety described by Morris and Lycett). Lincolnshire Limestone, Stoke Lodge. Apical and side; natural size. (Page 462.)
- 7 *a*, 7 *b*. *P.* (? *Scurria*) *nitida*, Deslongchamps. Inferior Oolite, Leckhampton. Jermyn Street Museum. Apical and side  $\times 3$ . (Page 461.)
- 8 *a*, 8 *b*. *P. Römeri*, Morris and Lycett. Lincolnshire Limestone, Stamford. Apical and side  $\times 3$ . (Scale of enlargement omitted on the plate.) (Page 463.)
- 9 *a*, 9 *b*. *P. fenestræ*, sp. nov. Chipping Norton Limestone. Windoes Collection. Apical and side; natural size. (Page 463.)
10. *Actæon* (*Tornatellæa*) *sculptus*, Lycett. *Opalinus*-zone, Drympton. Front  $\times 2$ . Fig. 10 *a*, body-whorl  $\times 3$ . (Page 467.)
11. *A.* (*Tornatellæa*) *ooliticus*, sp. nov. *Concavus*-bed, Bradford Abbas. Front  $\times 2$ . (Page 467.)
12. *A.* (*Tornatellæa*) *pulchellus*, Deslongchamps. *Parkinsoni*-zone, Grove. Front  $\times 2$ . (Page 466.)
13. The same. *Parkinsoni*-zone, Burton Bradstock. Front  $\times 2$ .
14. *Actæonina pulla*, Koch and Dunker (*vide* Morris and Lycett). Millepore-bed or Scarborough Limestone, Cloughton Wyke. Bean Collection, British Museum. Front  $\times 2$ . (Page 470.)
15. *Actæon* or *Actæonina Sedgwicki*, Phillips. Dogger, Peak. Bean Collection, British Museum. Back  $\times 2$ . (Page 469.)
16. *Actæonina "pulloides."* Lincolnshire Limestone, Weldon. Front  $\times 2$ . Fig. 16 *a*. Body-whorl  $\times 4$ . (Page 470.)
17. *Fossarus* (*Couthouya*) *ooliticus*, sp. nov. *Concavus*-bed, Bradford Abbas. Front  $\times 1\frac{1}{2}$ . (Page 492.)
18. *Actæonina* (*Striactæonina*) *tenuistriata*, sp. nov. Dogger, Peak. York Museum. Back  $\times 1\frac{3}{4}$ . (Page 471.)
19. The same. Dogger, Peak. Front  $\times 1\frac{1}{2}$ . Fig. 19 *a*, body-whorl  $\times 3$ .
- 20 *a*, 20 *b*. *A.* (*Striactæonina*) *humeralis*, Phillips. Dogger, Peak. York Museum. Back and front  $\times 2$ . (Page 472.)
21. *A. subovalis*, sp. nov. *Concavus*-bed, Bradford Abbas. Front  $\times 1\frac{1}{2}$ . (Page 472.)
22. *A.* (*Cylindrobullina*) *glabra*, Phillips. Lincolnshire Limestone, Barnack. Front  $\times 2$ . (Page 473.)
- 23 *a*, 23 *b*. The same. Millepore-bed or Scarborough Limestone of the Yorkshire coast. Bean Collection, British Museum. Back and front  $\times 2$ .







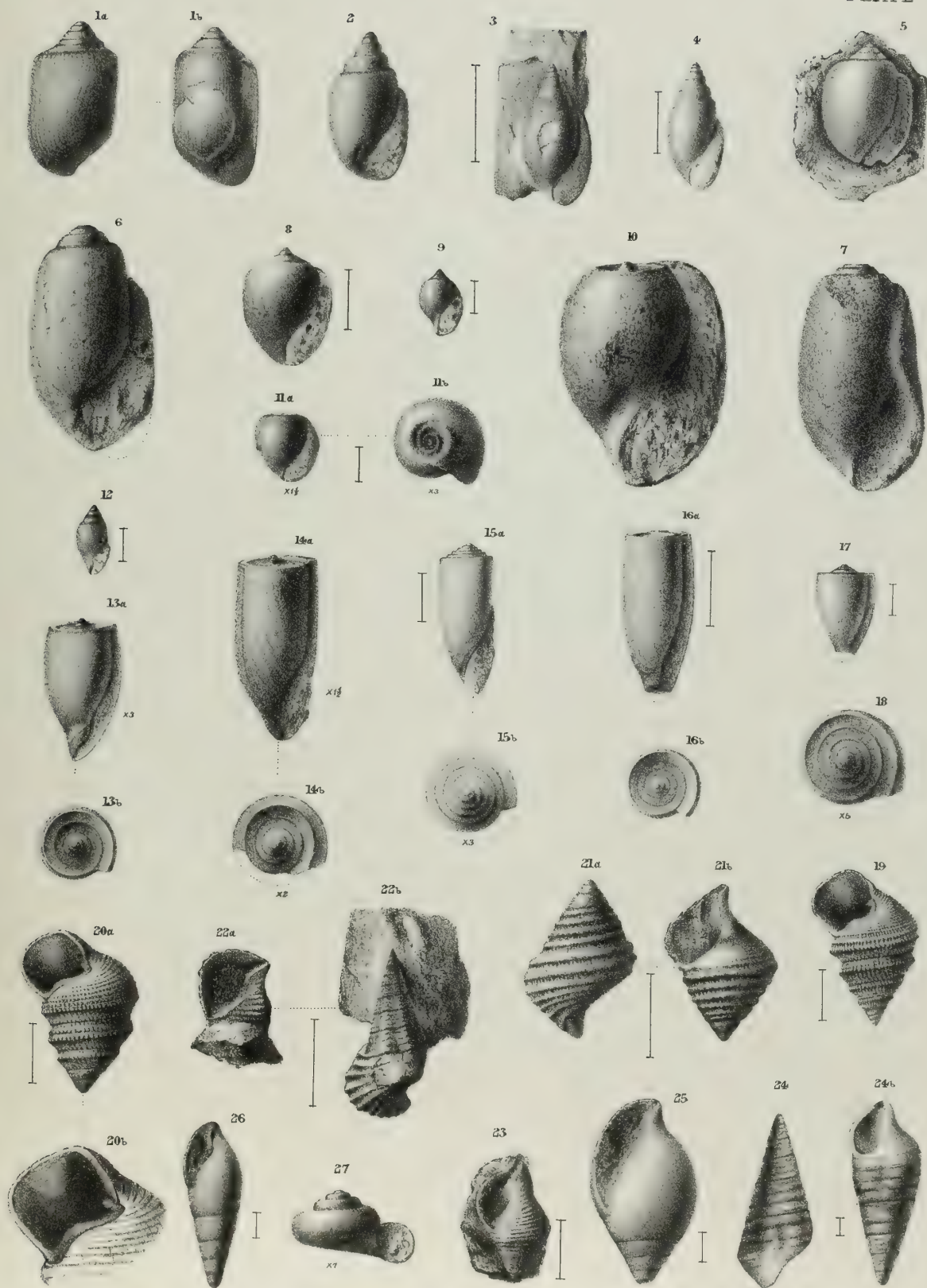


## PLATE XLIII.

FIG.

- 1 *a*, 1 *b*. *Actæonina* (*Cylindrobullina*) *cinerea*, Hudleston. Scarborough Limestone, Cloughton Wyke. Leckenby Collection, Woodwardian Museum. Back and front; natural size. (Page 474.)
2. *A. gigantea*, Deslongchamps (short variety). Inferior Oolite of the Cotteswolds. Jermyn Street Museum. Front; natural size. (Page 474.)
3. The same. Dean and Chapter pit, Lincoln. Front slightly enlarged.
4. *A. gigantea*, var. *attenuata* (near to *A. acuta*, d'Orb.). Dean and Chapter pit, Lincoln. Front  $\times 2$ . (Page 475.)
5. *A.* (? *Trochactæonina*) *tumidula*, Lycett. Scarborough Limestone, White Nab. Bean Collection, British Museum. Front  $\times 2$ . (Page 476.)
6. *A. antiqua*, Lycett. *Spinosa*-stage, Rodborough Hill. Jermyn Street Museum. Front; natural size. (Page 477.)
7. *A. convoluta*, Lycett. *Spinosa*-stage, Rodborough. Jermyn Street Museum. Front; natural size. (Page 477.)
8. *A.* (*Trochactæonina*) cf. *Esparcyensis*, d'Archiac (micromorph). Lincolnshire Limestone, Weldon. Front  $\times 1\frac{3}{4}$ . (Page 476.)
9. *A.* (*Trochactæonina*) ? *tumidula*, Lycett. Lincolnshire Limestone, Weldon. Front  $\times 2$ . (Page 476.)
10. *Bulla Favrei*, Lycett. Inferior Oolite, Avening. Jermyn Street Museum. Front; natural size. (Page 481.)
- 11 *a*, 11 *b*. *B.* (*Hydatina*) *undulata*, Bean (micromorph). Scarborough Limestone, Pickering Cliff. Front  $\times 1\frac{1}{2}$ ; apical  $\times 3$ . (Page 482.)
12. *Cylindrites turriculatus*, Lycett. Lincolnshire Limestone, Weldon. Front  $\times 2$ . (Page 478.)
- 13 *a*, 13 *b*. *C. tabulatus*, Lycett, var. *Weldonis*. Lincolnshire Limestone, Weldon. Jermyn Street Museum. Front and apical  $\times 3$ . (Page 480.)
- 14 *a*, 14 *b*. *C. tabulatus*, Lycett. Inferior Oolite, Nailsworth. Jermyn Street Museum. Front  $\times 1\frac{1}{2}$ ; apical  $\times 2$ . (Page 479.)
- 15 *a*, 15 *b*. *C. attenuatus*, Lycett. Pea-grit, Leckhampton. Front  $\times 2\frac{1}{2}$ ; apical  $\times 3$ . (Page 479.)
- 16 *a*, 16 *b*. *C. cylindricus*, Morris and Lycett (Inf. Ool. var.). ? Nailsworth. Jermyn Street Museum. Front and apical  $\times 2$ . (Page 481.)
17. *C. brevispira*, sp. nov. Lincolnshire Limestone, Weldon. Front  $\times 3$ . (Page 479.)
18. The same. Another specimen from the same locality. Apical  $\times 5$ .
19. *Chilodontöidea oolitica*, sp. nov. Beaminster. Front  $\times 2\frac{1}{2}$ . (Page 491.)
- 20 *a*. The same. *Concavus*-bed, Bradford Abbas. Front  $\times 2\frac{1}{2}$ . Fig. 20 *b*, aperture  $\times 5$ .
- 21 *a*, 21 *b*. *Brachytrema Pontonis*, sp. nov. Lincolnshire Limestone, Ponton. Back and front  $\times 2\frac{1}{2}$ . (Page 484.)
- 22 *a*, 22 *b*. *Cerithium* (*Colina*), *Lycetti*, sp. nov. Inf. Ool., Nailsworth. Jermyn Street Museum. Front (portion) and back  $\times 2\frac{1}{2}$ . (Page 485.)
23. *Brachytrema* species. Irony Nodule-bed, Burton Bradstock. Front  $\times 2$ . (Page 485.)
- 24, 24 *b*. ? *Brachytrema* "*prætenue*." Oolite Marl, Notgrove. Front and back  $\times 8$ . (Page 484.)
25. *Ceritella Stokensis*, sp. nov. Lincolnshire Limestone, Stoke Lodge. Front  $\times 5$ . (Page 487.)
26. *C. tumidula*, Lycett, var. *angusta*. Lower Limestone (of Witchell), Nailsworth. Front  $\times 6$ . (Page 486.)
27. *Valvata comes*, sp. nov. *Paludina*-bed, Langton Bridge. Front  $\times 7$ . (Page 489.)







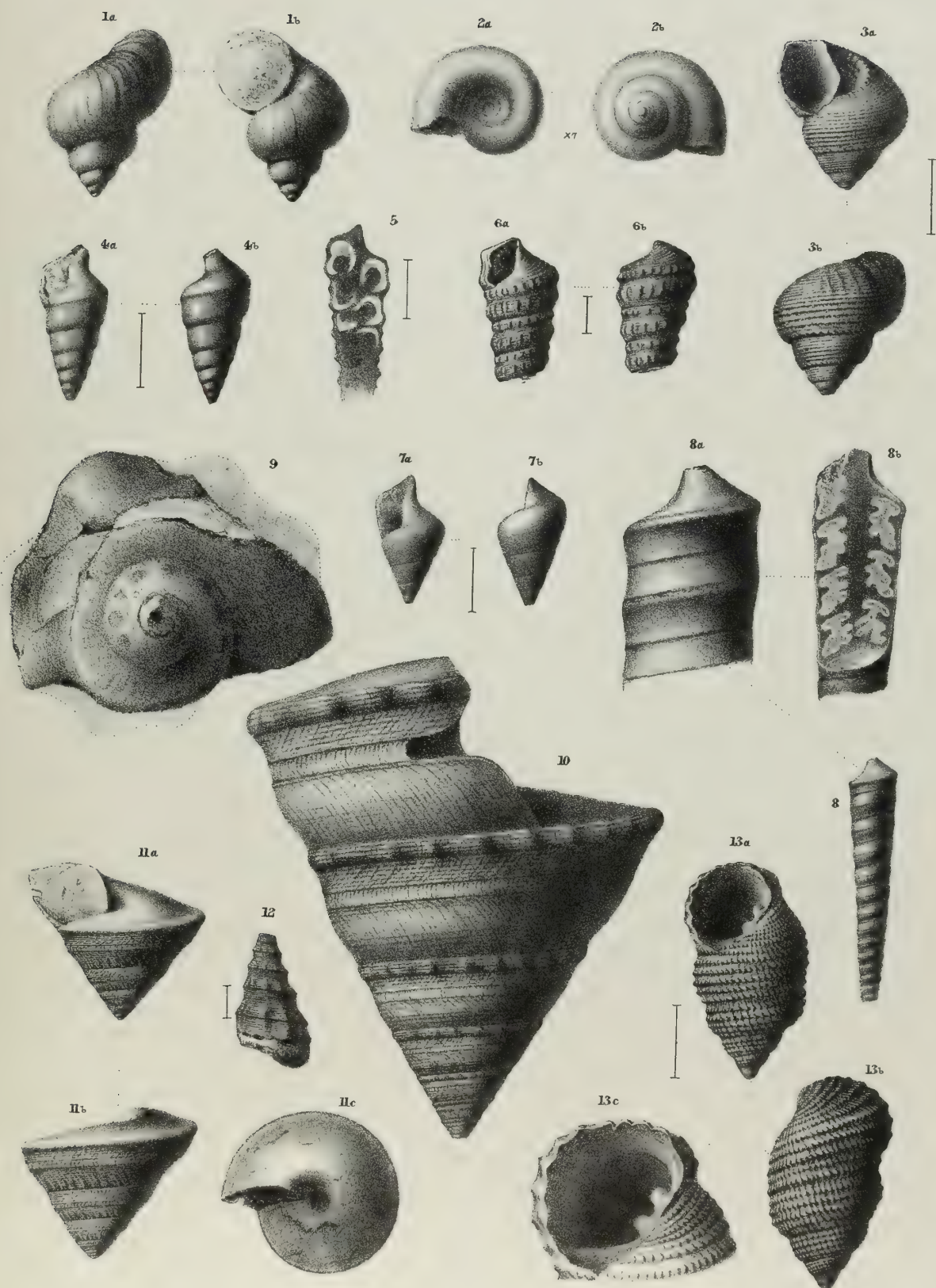


## PLATE XLIV.

### FIG.

- 1 *a*, 1 *b*. *Paludina Langtonensis*, sp. nov. *Paludina*-bed, Langton Bridge, Oxon. Back and front; natural size. (Page 488.)
- 2 *a*, 2 *b*. *Valvata comes*, sp. nov. *Paludina*-bed, Langton Bridge. Base and apical  $\times 7$ . (Page 489.)
- 3 *a*, 3 *b*. *Delphinula (Margarita)* species, near to *D. Santonis*, Hudleston. Cold Comfort, near Cheltenham. Front and back  $\times 1\frac{3}{4}$ . (Page 490.)
- 4 *a*, 4 *b*. *Nerinæa (Nerinella) neglecta*, sp. nov. Lincolnshire Limestone, Weldon. Front and back  $\times 2$ . (Page 487.)
5. *Cerithinella*, species. Lincolnshire Limestone, Leadenham. Longitudinal section  $\times 2\frac{1}{2}$ . (Page 487.)
- 6 *a*, 6 *b*. *Cerithinella*, probably the same species as fig. 5. Lincolnshire Limestone, Hungerton Hall. Front and back  $\times 3\frac{1}{2}$ .
- 7 *a*, 7 *b*. ? *Fibula velox*, sp. nov. *Murchisonæ*-zone of the Cotteswolds. Front and back  $\times 1\frac{1}{2}$ . (Page 486.)
8. *Nerinæa (Ptygmatis)* cf. *cingenda*, Phillips. Lincolnshire Limestone, Stoke Lodge. Back; natural size. Fig. 8 *a*, portion enlarged. Fig. 8 *b*, longitudinal section enlarged. (Page 488.)
9. *Purpuroidea*, species. Lincolnshire Limestone, Rauceby. Apical view; natural size. (Page 483.)
10. *Pleurotomaria subfasciata*, d'Orbigny. *Sauzei*-bed, neighbourhood of Sherborne. Natural size. (Page 420.)
- 11 *a*—*c*. *Pl. amata*, d'Orbigny. *Humphriesianus*-zone, Louse Hill. Front, back and base, natural size. (Page 418.)
12. *Cirrus*, species or variety. Lincolnshire Limestone, Stoke lodge. Back  $\times 4$ . (Page 490.)
- 13 *a*, 13 *b*. *Wilsonia liassica*, sp. nov. Junction of Middle and Upper Lias, Thorncombe, near Bridport. Front and back  $\times 2\frac{3}{4}$ . Fig 13 *c*, aperture further enlarged. (Page 492, foot-note.)













THE

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LONDON:

MDCCCXCVI.



A MONOGRAPH

ON

CARBONICOLA, ANTHRACOMYA,  
AND NAIADITES.

BY

WHEELTON HIND, M.D., B.S.LOND., F.R.C.S., F.G.S.

PART III.

APPENDIX AND INDEX,

PAGES 171—182; PLATE XXI.

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# MONOGRAPH ON CARBONICOLA, ANTHRACOMYA, AND NAIADITES.

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The Monograph on Carbonicola, Anthracomya, and Naiadites will be found in the Volumes of the Palæontographical Society for the years 1894, 1895, and 1896. The General Title-page, Appendix, and Index will be found in the Volume for the year 1896.

*Cancel* the Title-pages of Parts I, II, and III in the Volumes for the years 1894, 1895, and 1896, and *substitute* the General Title-page in the Volume for the year 1896.

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## 19.—SECTION BY MR. J. BENNIE OF THE SERIES AT DALMENY SHORE.

	Sandstone.
	White trap in black shale.
	Flinty limestone.
	Bituminous shale.
	Hard shale with <i>Lepidodendrons</i> and fish scales.
	Beds with ironstone and calcareous nodules.
	Shales with periostracum of <i>Naiadites</i> ? and <i>Sphenopteris</i> .
	Rocks with plant remains.
	Burdiehouse limestone.
	Black shale.
	Black shale with ironstone bands and Cyprid beds, <i>Anthracomya Adamsii</i> .
	Black shale with plants.
	Soft clayey shale with <i>Naiadites obesa</i> .
	Sandy beds with same shell and plants.
	Bituminous shales with same.

I am greatly indebted to many fellow-workers in this field of Palæontology, to whom I wish to render my sincere thanks. Especially to Professors Dewalque, J. Fraipont, and M. Lohest of Liège, Prof. Geinitz of Dresden, Dr. Otto Jaekel of Berlin, and to Mons. L. Dollo of Brussels, who kindly assisted me to study the series of Coal-measure fossils in the respective Museums to which they are attached.

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Also to Sir A. Geikie, Director-General, and Messrs. E. T. Newton, De Rance, Goodchild, and Nolan, of the Geological Survey of Great Britain and Ireland, for great assistance in the loan of type specimens from the Survey Museums of London, Edinburgh, and Dublin, and for valuable information on many points. Also I have to thank Mr. F. R. C. Reed, of Cambridge, for kindly showing me the Woodwardian Collections on two occasions, and Mr. Bolton, of Owens College, Manchester, for his kindness in giving up to me a work which he had already begun, and for looking over proofs for me; and Mr. William Rupert Jones, who kindly verified references and made several bibliographical researches for me.

I owe a special debt of gratitude to the Rev. Prof. Thomas Wiltshire and Prof. T. Rupert Jones for many valuable suggestions and much help.

## APPENDIX.

### *Bibliography.*

1853. In a paper "On the Coal-measures of the South Joggins, Nova Scotia," Sir W. J. Dawson at p. 39 figures two shells as *Modiolæ* (figs. 22 and 23), and two as *Uniones* (figs. 24 and 25), from these measures. No specific names.

1862. Winchell described, in the volume of the 'Proceedings of the Academy of Natural Science of Philadelphia' for 1862, p. 413, *Cardinia complanata*, *C. æquimarginalis*, said to be closely allied to *C. robusta*, and *C. concentrica*, from Carboniferous beds of the Marshall and Huron groups of Michigan.

1864-5. Messrs. Meek and Worthen ("Palæontology of the Upper Missouri," part i, p. 34, 'Smithsonian Contributions to Knowledge,' No. 172) include *Carbonicola* (spelt *Carbonocola*) in the family *Crassitellidæ*, with *Astarte*, *Crassatella*, *Cardita*, &c., and a very large number of fossil genera of most diverse characters,—*Venericardia*, *Pachydomus*, *Astartila*, *Astartella*, *Cardinia*, *Hippopodium*, *Pleurophorus*, and various others.

At p. 36. *Anthracomya* is included in the family *Anatinidæ*, with *Anatina*, *Thracia*, *Pandora*, and *Pholadomya*, and other recent genera, and with the fossil genera *Carcomya*, *Allorisma*, *Myciates*, *Arcomya*, *Cardiomorpha*, *Sedgwickia*, *Sanguinolites*, and others. Such a group, with scarcely a character in common, cannot be admitted for a moment.

1875. Baily gives a figure of *Carbonicola ovalis* under the name *Anthracosia centralis* in his 'Figures of Characteristic British Fossils,' p. 115, pl. xxxix, fig. 8, from the Coal-measures of Wednesbury, South Staffordshire.

1878. Bigsby's 'Thesaurus Devonico-Carboniferus' gives lists of all the then known species of Devonian and Carboniferous Lamellibranch fossils. The following are from American Carboniferous strata (p. 296) :

<i>Anthracosia æquimarginalis</i> , <sup>1</sup> Winchell.	
— <i>Antigonesensis</i> , Dawson.	
— <i>Bradorica</i> , Dawson.	

<i>Anthracosia concentrica</i> , <sup>2</sup> Winchell.	
— <i>fragilis</i> (?), Cox.	
— <i>nana</i> , Owen.	

<sup>1</sup> This shell is referred to *Edmondia* by S. A. Miller.

<sup>2</sup> This shell is referred to *Sanguinolites* by S. A. Miller.

*Anthracosia occidentalis*, Swallow.  
 — *subangulata*, Dawson.  
*Anthracoptera carbonaria*, Dawson.

*Anthracoptera fragilis*, Meek and Worthen.  
 — *lævis*, Dawson.

1889. S. A. Miller, in his work on 'North American Geology and Palæontology,' gives at p. 462 a brief definition of the genus *Anthracomya*, referring several of Dawson's Acadian species of *Naiadites* to this genus, amongst them *Naiadites carbonaria*. On p. 463 he gives short definitions of *Anthracoptera* and *Anthracosia*, referring *A. polita*, White, to the former, and *A. Bradorica* to the latter genus.

1894. A paper entitled "Revision of the Bivalve Mollusks of the Coal-formation of Nova Scotia," by Sir W. J. Dawson, was issued by the Peter-Redpath Museum. He reviews the whole question of the nomenclature of *Anthracomya* and *Naiadites*, and figures the following new species:—*Naiadites longus*, *N. mytiloides*, and *Anthracomya obtenta*. The older species are re-figured, and remarked upon at length.

1896. Holroyd and Barnes, in vol. xxiv, pt. 5, 'Transactions Manchester Geol. Soc.,' "On the Rocks and Fossils of the Yoredale Series of the Marsden and Saddleworth Valleys," note the occurrence of several species of *Carbonicola* in that series, amongst which I note *C. turgida*, *C. acuta* (small), and *C. aquilina*.

#### *Additional Notes on the Species.*

*Carbonicola robusta* (p. 45).—On p. 48 I remarked that the only specimens of this species that I had seen with eroded umbones were from Codnor Park, Derbyshire. I have since then acquired several specimens from Shotts, which show this condition remarkably well, one of which I figure, Pl. XXI, figs. 11 and 12. The name *Unio discrepans*, Brown, 1849, 'Fossil Conchology,' p. 213, pl. lxxxviii, fig. 24, should be added to the synonymy of *C. robusta*.

*C. ovalis* (p. 56).—To the synonymy of this species should be added *Anthracosia centralis*, Baily, 1875, 'Figures of Characteristic British Fossils,' p. 115, pl. xxxix, fig. 8.

*C. obtusa* (p. 61).—This shell has been found in fair abundance in a bed of black shale a few yards above the Moss Coal in sinking a new pit at Longton, North Staffordshire Coal-field. It occurs with *C. gibbosa*, *C. aquilina*, *C. acuta*, and *C. turgida*.

*C. nucularis* (p. 63).—This species occurs in large quantities in the "cockle-shell" bands above the Rushey Park seam, St. Helens. The shells from this locality are much larger than those found in North Staffordshire, and exhibit



much variation in form. One is figured Pl. XXI, fig. 8. It has also been found in the roof of the Bute seam, Dyllas Colliery, South Wales.

*C. aquilina*.—To the synonymy of this species must be added *Unio littoralis*, Brown, 1849, 'Fossil Conchology,' pl. lxxxviii, fig. 7.

The Ure Collection is, I find, preserved in the Museum of the Royal Society of Edinburgh, and the Council have kindly lent me the shell which is supposed to be Ure's "mussel," and which should therefore be the type of Fleming's *Unio Urei*. This shell, which is figured on Pl. XXI, fig. 1, is not very easy to identify, but I believe it to be a young specimen of *Carbonicola acuta*. Sowerby's shell is published in vol. i of the 'Mineral Conchology,' which is dated 1813; Fleming's 'History of British Animals' is dated 1826; therefore *Unio Urei* must be placed as a synonym of *Carbonicola acuta*, and not, as I have suggested p. 69, of *C. aquilina*. I would point out that the shell now figured differs much in size from Ure's original drawing, the latter being the representative of a much more massive and older shell.

To the localities where *Carbonicola aquilina* is obtained should be added the roof of the 4-foot seam, Bwllfa Colliery, and the roof of the 2-foot 9-inch seam, Galli, and a bed of Ironstone, Aberdare, all in the South Wales Coal-field. Also the Yoredale series of Marsden, Pule Hill.

*Carbonicola similis* (p. 76).—Some fine specimens of this shell have been obtained from some Ironstone measures at Aberdare, by Mr. O'Connor.

*Carbonicola turgida*.—To the localities for this species (p. 67) should be added the Ironstone seam of Aberdare, and Pule Hill in the Yoredale series.

*Anthracomya Adamsii* (p. 89).—This shell has been obtained in a bed of ironstone at Aberdeen by Mr. O'Connor, and in a bed of black shale with Ironstone band and Cyprid beds a little way below the Burdiehouse limestone on the shore at Dalmeny by Mr. James Bennie. The specimens are all crushed flat, but have the periostracum well preserved.

*Anthracomya modiolaris* (p. 95).—This species has been obtained by Mr. O'Connor from the roof of the 4-foot coal, Bwllfa Colliery, South Wales.

*Anthracomya senex* (p. 111).—A very perfect example of this species has been obtained by Mr. O'Connor from a bed of Ironstone at Aberdare; I have also obtained this species from the Lancashire Coal-field.

*Anthracomya Wardi* (p. 105).—Mr. O'Connor has obtained this species from the roof of the Ellad seam, Brysbach, South Wales Coal-field.

Two very fine shells obtained from the Possil Lower Black-band, in the collection of Dr. John Young, resemble very closely certain smaller shells which I figured on Pl. XIII, figs. 13, 15, and 16. All the other adult forms, and most of the young ones of this species which have come to hand, are compressed, and otherwise distorted (Pl. XV, figs. 12—16, 18, and 20). The position of the umbones and

the characteristic form of the anterior end and the subparallel margins appear to me to be typical of *A. Wardi*.

Dr. Young tells me that these are the only shells of this species known from this locality, and that he has not met with this form before. I have no hesitation in referring them to the genus *Anthracomya*, and to the same species as figs. 13 and 15 of Pl. XIII, although the Possil shells are so much finer than any others. Conditions must have been extremely suitable for the growth and development of the shell in this locality, and it is remarkable that no more specimens are to be met with in Scottish collections. Dr. Young informs me that crushed forms of *Naiadites*, probably *N. modiolaris*, occur with this shell, and that *Lingula squamiformis* also is found in bands of black shale in connection with the Possil Lower Ironstone, but that *Naiadites* and *Lingula* never occur in exactly the same stratum.

Of Dr. Young's two specimens one is very much larger than the other. The finer example (Pl. XXI, fig. 9) is, however, somewhat crushed and imperfect at the anterior end, and does not show the typical form of the shell so well as the other (Pl. XXI, fig. 10).

This shell measures—

Antero-posteriorly	.	.	.	.	66 mm.
Dorso-ventrally at umbo	.	.	.	.	23 „
Laterally	.	.	.	.	15 „

*Anthracomya Phillipsii* (p. 120).—Pl. XXI, fig. 7, is a non-compressed example of this species from the Upper Coal-measure shales, Speedwell Pit of the Gloucestershire Coal-field. Typical compressed examples occur in the same shales.

*Anthracomya dolobrata* has also been obtained from the Lancashire Coal-field; two specimens, of which I figure one, fig. 13, are assuredly young.

16. ANTHRACOMYA SUBPARALLELA, *Portlock*, sp., 1843. Plate XVII, figs. 1 and 2;  
Plate XXI, figs. 2—6.

MODIOLA SUBPARALLELA, *Portlock*, 1843. Report Geology County Londonderry, &c., p. 433, pl. xxxiv, fig. 16.

— — — *Morris*, 1843. Catalogue of British Fossils, p. 92.

? CARDINIA SUBPARALLELA, *Keyserling*, 1846. Petschora Land, p. 255, pl. x, fig. 15.

— — — *d'Orbigny*, 1850. Prodrome de Paléontologie, p. 131.

— — — *Eichwald*, 1860. Lethæa Rossica, 2nd part, p. 1007.

MODIOLA MACADANII, *Baily*, 1875. Figures of Characteristic British Fossils, p. 114, pl. xxxix, fig. 6.

MODIOLA MACADAMII, *Kinahan*, 1878. *Manual of the Geology of Ireland*, pl. iii, fig. 4.

— SUBPARALLELA, *R. Etheridge*, 1888. *Fossils British Palæozoic*, p. 285.

*Specific Characters*.—Shell moderately convex, especially in front, transversely oblong. Superior and inferior borders subparallel. The anterior end is short, convexly swollen, and has an almost semicircular margin, passing gradually below into the inferior border, which is straight, or with an almost obsolete sinuation a little anterior to its centre. The posterior border is truncate, almost straight above, rounded below. The hinge-line is straight and long. The umbones are tumid, obtuse, elevated above the hinge-line, and continuous, slightly excavated in front by a well-marked but small lunule; and are situated very anteriorly in the anterior one-sixth of the shell. The valves are convexly swollen; there is a shallow contraction which passes obliquely downward and backward from the back to the lower margin, becoming wider as it nears the lower edge of the valve, which indistinctly marks off the anterior from the posterior part of the shell. Posterior to this sulcus the shell is diagonally swollen from the umbo to the posterior inferior angle, the swelling becoming less marked as it proceeds backwards. Above the swelling the valves are flattened and compressed into the hinge-line and posterior border.

*Interior*.—Casts show the usual arrangement of the adductor and accessory muscle-scars.

The hinge is edentulous, and consists of a thickened mass in front, strongly connected with the shell, situated immediately below the umbo, which projects downwards, and is slightly bevelled at the expense of the upper portion, and of a smooth elongated part posteriorly bevelled at the expense of the lower margin.

*Exterior*.—The surface is ornamented with many very fine, thread-like striæ and lines of growth parallel to the border of the valves. Shell thin.

*Dimensions*.—The type-specimen, Pl. XXI, fig. 2, measures—

Antero-posteriorly	.	.	.	.	25 mm.
Dorso-ventrally	.	.	.	.	9.5 „
Elevation of valve	.	.	.	.	4 „

*Distribution*.—In Carboniferous shales at Ballynascreen, and Slieve Gullion, co. Derry; Clogher, co. Tyrone, and Ballycastle, co. Antrim. Lower Carboniferous shales of co. Cork and co. Tipperary (Baily).

*Observations*.—This shell is very distinct from those named *Modiola Macadamii* by Portlock, although he was not altogether of this opinion, for he says, “ Though this appears so very distinct a form from *Modiola Macadamii*, I am disposed to think that they all merge one into the other.” As a matter of fact two of the varieties of *M. Macadamii* are very distinct indeed, and all are totally different



from the shell under description. The shale in which *A. subparallela* occurs is lithologically distinct from that in which the other forms are found.

I had figured two specimens, Pl. XVII, figs. 1 and 2, from the cabinet of Mr. Joseph Wright, of Belfast, and remarked at p. 88, *ante*, that my attention had been drawn to the resemblance between this shell and those of the genus *Anthracomya*; and since that time I have been able to study the original specimen on which the species was founded, now preserved in the Museum of the Geological Survey, Jermyn Street, and some more specimens from Ballycastle in the Belfast Museum, two of which have the hinge exposed. This material came into my hands after the letterpress of my observations on *Anthracomya* was printed off, but I mentioned the fact that I had come to the conclusion that the shell really belonged to that genus in a note on the page of explanation to Pl. XVII.

I now re-figure the original type by the kind permission of Sir A. Geikie, and a specimen showing the greater part of the hinge by the permission of the authorities of the Belfast Museum. The hinge, it will be noted, differs from that of *A. modiolaris* in not possessing an elongated posterior lateral tooth, so that this character cannot be considered typical of the genus. I have not met with *A. subparallela* in the beds at Hollywood, near Belfast, where *Modiola Macadamii* occurs.

This species resembles more nearly *A. punctata* than any of the others, but is more convex, the lateral constriction is better marked, and the lines of growth are somewhat oblique to the long axis of the shell.

There is a fine slab of this species in the Geological Survey Collection at Dublin from Slieve Gullion, Derry, showing a large variety of shells in various stages of growth. In the younger shells the oblique sulcus is more marked.

Baily ('Figs. Char. Brit. Foss.,' 1875) evidently considered all the forms described by Portlock as one, for he figures *M. subparallela*, and in the text (p. 114) unites it with *Macadamii* of Portlock and its varieties.

Keyserling and Eichwald both referred specimens from Russian Carboniferous beds to Portlock's species, but altered the generic name to *Cardinia*.

A figure is given by Keyserling (op. sup. cit.), and this differs somewhat in contour from Portlock's type. Eichwald's description is short, and would do for *A. subparallela*.

*Naiadites modiolaris* (p. 131).—To the localities for this shell should be added the roof of the 2-foot 9 seam, Galli Colliery, and the roof of the 4-foot seam, Bwllfa Colliery, South Wales.

*N. carinata* also occurs in the latter bed.



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## ERRATA.

Page 5, line 4, *for* Limestone *read* Ironstone.

„ 20, line 17, the 1st part of 'Mélanges paléontologiques' is dated 1848.

„ 20, „ 3 from bottom, *for* Bronn *read* Brown.

„ 21, to list of Coal-measure shells described in Brown's 'Fossil Conchology,' add *Unio littoralis* and *U. discrepans*.

„ 38. The line "Class PELECYPODA (LAMELLIBRANCHIATA)" should be above (not below) the line "ASIPHONIDÆ (INTEGROPALLIATA)."

„ 58, line 19, *for* Leicester *read* Derby.

„ 63, line 11 from bottom, *for* Leicestershire *read* Derbyshire.

„ 78, line 7 from bottom, *for* Bronn *read* Brown.

„ 131, line 6 from top, *for* Rabchester *read* Ribchester.

„ 158, 3rd line from bottom, *for* bars *read* bands.

Explanation of Pl. IV, 2 lines from bottom, *for* Leicestershire *read* Derbyshire.





## PLATE XXI.

Fig. 1.—*Carbonicola acuta*. The original of Ure's "mussel" from East Kilbride. In the Collection of the Royal Society of Edinburgh. (Page 175.)

Fig. 2.—*Anthracomya subparallela*. The original of Portlock's *Modiola subparallela*. In the Collection of the Geological Survey, Jermyn Street. (Page 176.)

Fig. 3.—*Anthracomya subparallela*. A specimen showing the hinge, in the Collection of the Belfast Museum. (Page 176.)

Figs. 4, 5.—*Anthracomya subparallela*. From Carboniferous shale, Slieve Gullion, co. Derry. In the Collection of the Geological Survey, Dublin. (Page 176.)

Fig. 6.—*Anthracomya subparallela*. A cast showing the muscle-scars, from the Carboniferous of Ballycastle. In the Collection of the Belfast Museum. (Page 176.)

Fig. 7.—*Anthracomya Phillipsii*. Not crushed. From the Gloucester Coal-field. My Collection. (Page 176.)

Fig. 8.—*Carbonicola nucularis*. Large form from the "Cockle-shell" band above the Rusty Pack seam, St. Helens. My Collection. (Page 174.)

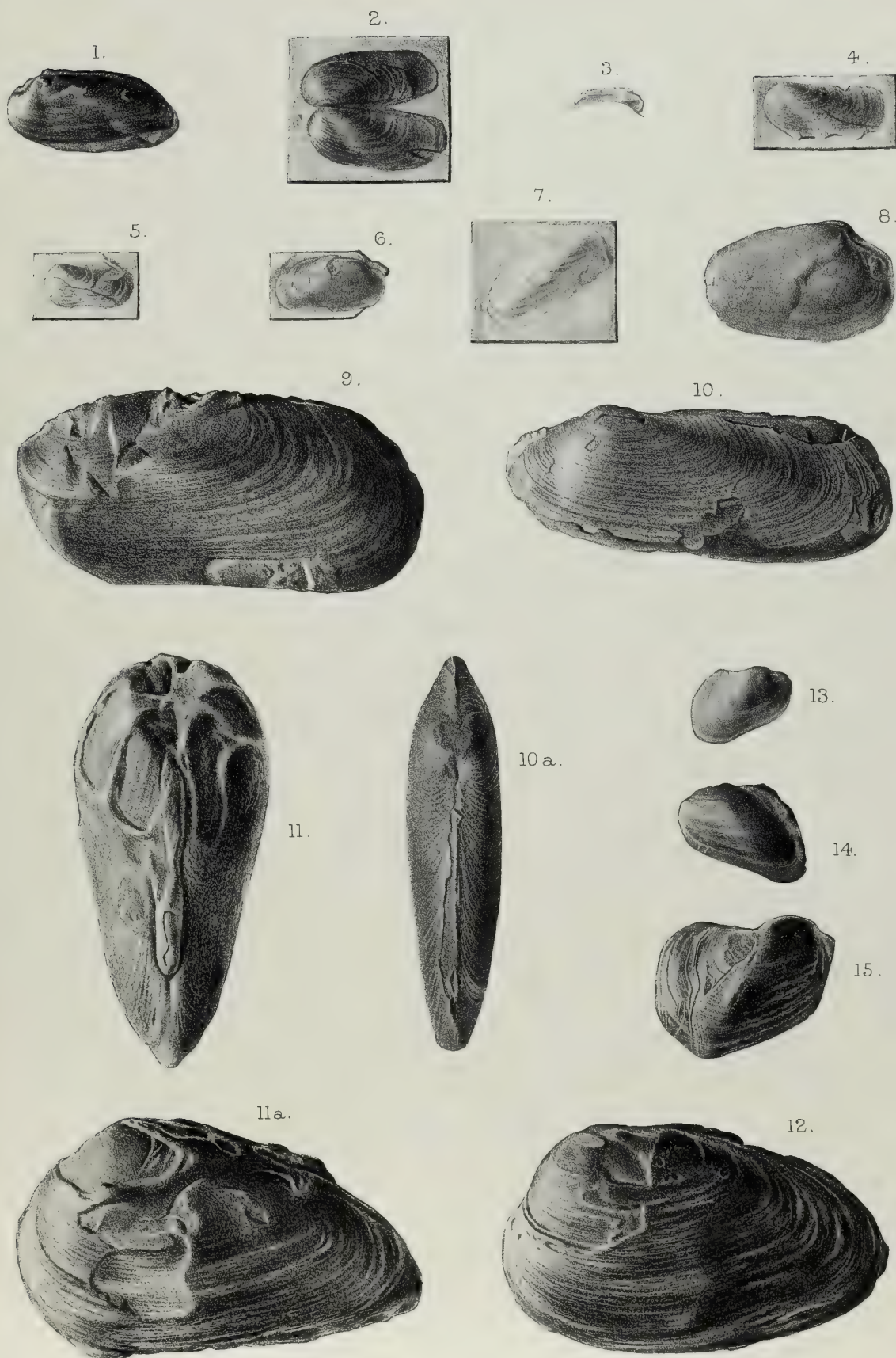
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A MONOGRAPH  
OF THE  
BRITISH CARBONIFEROUS  
LAMELLIBRANCHIATA.

BY  
WHEELTON HIND, M.D., B.S.LOND., F.R.C.S., F.G.S.

PART I.  
INTRODUCTION, BIBLIOGRAPHY, MYTILIDÆ.

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# A MONOGRAPH

OF THE

## BRITISH CARBONIFEROUS LAMELLIBRANCHIATA.

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### INTRODUCTION.

No systematic work on British Carboniferous Lamellibranchiata has been attempted since the publication of M'Coy's two great works in 1844 and 1854-6. Since then systematic conchology has greatly advanced, and, at the same time, palæontological material has been accumulated to a very large extent; fortunately, too, in many cases specimens or fragments have been obtained in special states of preservation, which have demonstrated the characters of the hinge-structure and the position of muscle-scars, and the character of the pallial line—features which, in the necessary absence of the soft parts of the animal, are made use of as a basis of conchological classification. Owing to the fact of the preservation of these essential characters, many changes have been found necessary in the generic nomenclature; and will be adopted in the following Monograph.

The study of the bivalve shells of the Carboniferous age has been largely carried on, both in Belgium and North America, by learned and competent observers, consequently much uncertainty has been caused by such independent and widely separated research, authors being unwilling, in the absence of specimens, to admit that the same species had a world-wide distribution; and the result has been that, both generically and specifically, a large synonymy has been created.

In nearly every case the older palæontologists named their specimens from the observation of external characters only, and often from a supply of specimens too limited to ascertain the real type of a genus or species; and it has generally been the rule to regard the survival of genera and species as altogether limited to those periods adopted for the purposes of stratigraphical classification, and to hesitate to recognise the same form in the beds of two or more different epochs.

The all but universal acceptance, by working conchologists, of the Darwinian theory of evolution by variation has to a large extent changed the views which older observers held on the permanence of species. It may be now regarded as an

aphorism that the larger the number of specimens examined the fewer the species determined, or that the number of species varies inversely with the number of specimens studied.

The question of species, and to some extent that of genera, is largely a personal one. Each individual observer gives a different value to variations in shape, size, or even to small anatomical differences; and when, as in palæontological research, it is impossible to obtain any but the most elementary evidence of the anatomy of the animal itself, and one organ—the test—has to furnish the characters for classification, the most reliable portions, the hinge and interior, often being invisible (together with the imperfections of the geological record), an approximation only can be made to accuracy in zoological determinations.

The work of American authors is scattered through numerous publications access to which is often difficult. In many cases no figures accompany the descriptions, and the type specimens are not recorded, and are scattered over that Continent in private collections. Very few British species are recognised as occurring in American Carboniferous rocks, though there is a very close resemblance between the two faunas, and but small differences seem to exist in many cases between British and American species—an extent of variation not greater than would be expected to exist in a single species surviving in such widely separated areas. The greater accuracy in generic delineation is greatly due to the recognition by American authors of the importance of the internal characters of the shell, and to the fine state of preservation in which in many cases specimens occur in American beds. Many of their generic names have been accepted by de Koninck and others, in order to mark off recent from palæozoic fossil genera.

Fortunately in many cases the original types of the published British Carboniferous Lamellibranchs are still extant. The “Ure Collection” is preserved in the Museum of the Royal Society of Edinburgh.

The few forms described and figured by Sowerby in the ‘Mineral Conchology’ are, the writer believes, all present in the Sowerby Collection of the Natural History Museum at South Kensington, and in the same place are those specimens which were described by Phillips in the ‘Geology of Yorkshire,’ from the Gilbertson Collection, while Portlock’s specimens are all safe in the Museum of the Geological Survey at Jermyn Street. The Griffiths Collection, the basis of M’Coy’s first great work, is preserved in the Science and Art Museum, Dublin; but many of the specimens figured, probably those from private collections, have been lost sight of. The specimens figured in M’Coy’s second great work are all in the Woodwardian Museum at Cambridge, while those described by the palæontologists of the Geological Survey are in the museums of that Department in London, Edinburgh, and Dublin. By the courtesy of the custodians I am permitted to refigure in every case the original specimens.



Occasionally the original type is absent from some of these collections, and at times its place is taken by one or more specimens from the same locality whence the original specimen was obtained. A certain number have, unfortunately, altogether disappeared; and it will be necessary, owing to absence of any accurate and detailed diagnosis, to drop certain names of long standing, since it is impossible now to obtain the slightest indication of what the original shell was like. An example of such a case is the *Modiola granulosa* of Phillips, the original of which is stated to have been drawn from a specimen in the Museum of the Yorkshire Philosophical Society. But there is no specimen there that in any way can be referred to the drawing, and the whole of the description is contained in the five words "very elongated, depressed, surface granulose," which convey no meaning of any diagnostic value.

There is a very great initial difficulty in determining the proper place in general classification which the Palæozoic genera of the Lamellibranchiata should occupy. In many cases no recent representatives seem to exist; and, even with full details as to hinge-structure, it is a matter of great uncertainty as to which family a genus should be referred. Several of the Carboniferous genera seem to fall into natural groups; for example, *Cardiomorpha*, de Koninck; *Isoculia*, M'Coy; *Broekia*, de Koninck; *Pachydomus*, Morris; *Edmondia*, de Koninck; and *Scaldia*, de Ryckholt, have much in common, but can be distinguished by well-marked characters; but the real position of this family is so uncertain that de Koninck, in spite of the absence of a sinuated pallial line in all members of the group, places the six genera under the *Anatinidæ*; while M'Coy refers *Edmondia* to the *Mytilidæ*, and *Cardiomorpha* to a new family placed directly after the *Mytilidæ*. More light will be thrown on these still obscure points only when a careful comparison can be made between the Palæozoic and Mesozoic shells, to permit of which it will be necessary to obtain the hinge-plate of each genus.

It is impossible, in the present state of our knowledge, to attempt to arrange the various genera under their proper families; but the writer hopes to be able to do so at the end of his work, when the tangled web of synonymy shall have been unravelled, and some definite information has been obtained of the genera of the Lamellibranchiata which existed in Carboniferous times. Owing to the want of material and other causes, the chief of which is the very excessive number of species that have been figured and described by various authors, it has been necessary to leave the study of the Carboniferous representatives of the families *Pectinidæ* and *Aviculidæ* for a future time. This work, therefore, commences with genera of the family *Mytilidæ*, which existed in Carboniferous times. An attempt will be made to proceed systematically from this point, though, owing to the present uncertainty as to the true family position of certain genera, some rearrangement may be found to be necessitated in the final *résumé*.

The species of certain families of Carboniferous Lamellibranchs—*Carbonicola* (*Anthracosia*), *Anthracomya*, and *Naiadites* (*Anthracoptera*)—having been fully described in a former Monograph, will be only briefly alluded to in the present work; but it is deemed inadvisable to omit them altogether, as these genera form intermediate links between other Palæozoic groups.

The greatest systematic work on the subject of this Monograph is that by L. de Koninck, a brief synopsis of which will be found hereafter. I have had the opportunity of personal examination of all the specimens in the collection of types in the Musée de l'Histoire Naturelle at Brussels, which formed the material for that work, owing to the kindness of Professor Dupont. These specimens are all from the "Calcaire Carbonifère" of Belgium, and as a fauna differ very markedly from that which obtains in British rocks of Carboniferous age, only about 8 per cent. of all the species described being recognised as occurring in British rocks.

This difference is, I think, largely due to differences in the deposits in the two areas. In Great Britain the larger number of our Carboniferous bivalves are obtained from the shales and argillaceous deposits which were probably laid down contemporaneously with the great "Massif" of limestone in Belgium, and with the smaller masses in Derbyshire, Somersetshire, Wales, and Ireland. But these English deposits, judging from many collections, do not appear to contain a fauna by any means rich in Lamellibranchs. In Ireland, however, conditions were somewhat more favorable to the growth of bivalves, for M'Coy described 195 species from the Carboniferous Limestone; a number which is probably far in excess of the truth, as many species were founded on mere variations of shape and size; and it is probable that in the case of the Pectinidæ, of which genus sixty-nine species were described, the varied ornament and sculpture of the right and left valves served to separate the two halves of a shell into two species.

Mr. G. H. Morton,<sup>1</sup> in a careful and exhaustive work on the Carboniferous Limestone of North Wales and its fauna, only mentions twenty-four species of Lamellibranchs as occurring within the district in which he laboured, and these only very sparingly.

The Brachiopoda are by far the most common fossils in the Carboniferous limestones of England and Wales, both as regards numbers and wideness of distribution. They are by no means evenly distributed throughout the mass, or even in the same bed; certain portions of limestone are almost wholly made up of fossil shells, others are almost free from them; but the fossiliferous pockets are comparatively rare, and the shells are almost all broken and the valves separated, affording evidence that the shells are not exactly in the place where they lived. This is not the case where the shells are obtained from the shales intercalated between the thin beds of limestone in the Northumbrian Scottish area.

<sup>1</sup> 'Proc. Liverpool Geol. Soc.,' 1876—1878, and 1886.



Various attempts at classification have been made in the case of Carboniferous strata, but with no very satisfactory result. For while it is easy to classify the rocks which represent, in any area, the Carboniferous beds, it is with great difficulty that any decision can be arrived at as to the exact equivalents of the beds in two series of rocks of different areas. It appears to me, from lithological and palæontological points of view, that the rocks which represent the Carboniferous period in Northumberland and Scotland were laid down on a slowly sinking floor in very shallow water, at times probably fresh or very slightly brackish, while occasionally depression went on more rapidly and deeper marine conditions obtained. In the Derbyshire area, at first, a steady marine deposition was going on at some considerable depth; but as time went on the land sank less rapidly, the sea basin became almost filled, the shallow water or shore beds extended further south, and the continuous formation of calcareous ooze was replaced by the deposition of the muds and sands brought down by river and other agents of surface denudation, not permanently at first, owing to oscillations in the rate of the lowering of the land. Little can be known of the comparative rates of the deposit of the alternating beds of the Calciferous Sandstone group and the Mountain Limestone, because, on the one hand, the succession and repetition of strata point to varied rates of deposit, and the rich fossil flora and seams of coal entombed in the rocks indicate intervals in the deposit, and it is impossible to gauge the length of time during which the terrestrial conditions obtained. From a palæontological point of view, deposits of varied depth would naturally contain faunas of different aspect, and therefore fossils can hardly be relied upon to indicate stratigraphical Equivalents, though they may, in any area, mark out zones or horizons; for as the depth or clearness of the water and condition of the bottom altered, new forms would migrate; and thus in one locality certain forms would be found in horizontal sequence to others (and consequently, from the point of view of time not contemporaneous), which had been living contemporaneously in different areas: and thus in the Anglo-Scottish Carboniferous area, as the sea deepened, southern forms would extend northward, and be intercalated between beds containing shallower fauna; while as the basin filled up the shallow water fauna would migrate south, and overlies that which was characteristic of deeper water. In the Calciferous Sandstone series of the Fifeshire coast it would appear that alternating conditions were repeated; such lithological repetitions being accompanied by the fresh invasion of a fauna which had been driven away from the area by an unsuitable environment, but which had evidently survived in some other area, and was able, when suitable conditions reappeared, to migrate back again, but at a higher level, to its old haunts. Certain species, it is true, appear to have been able to survive under very varied conditions; but a close examination will show a great variation in size—for

example, in shale beds *Productus semireticulatus* does not attain to the size which is characteristic of this species in the Mountain Limestone. Many similar examples can be quoted amongst the group of Lamellibranchs. I have pointed out in a previous Monograph<sup>1</sup> how the size of *Naiadites crassa* varies as it occurs in limestones or shales, and the same thing may be noted in the case of *Schizodus Salteri* in the limestone at Randerston, Fifeness, and the shale at Woodhall, near Edinburgh. It is very interesting to note the dwarfed condition of those typically marine fossils which are contained in certain narrow bands in the Coal Measures of Lancashire and Staffordshire. These beds contain a fauna comparatively rich in species, most of which occur in the Lower Carboniferous rocks, demonstrating a prolonged survival in some external area until the marine conditions necessary for their existence recurred in these areas. The following list of fossils recognised as occurring in the roof of the Gin Mine or Golden Twist of North Staffordshire has altogether a Lower Carboniferous facies :

*Discites subsulcatus.*

*Goniatites excavatus.*

— *striatus.*

— *multilobus.*

*Cypricardia glabrata.*

*Aviculopecten*, sp.

*Euomphalus tuberculatus.*

*Pleurotomaria*, sp.

*Productus semireticulatus.*

*Spirifer Urei.*

*Axinus (Schizodus)*, sp.

*Orthoceras*, sp.

*Solemya primæva.*

*Chonetes Laguessiana.*

*Nucula gibbosa.*

— *lineata.*

*Leda clavata.*

*Macrocheilus Michotianus.*

*Loxonema*, sp.

*Bellerophon Dumontii.*

But most of the species are very much dwarfed, the *Productus* being very small indeed.

The marine fauna of the Pennystone beds of Coalbrookdale is very interesting, both in point of view of its richness in Lamellibranch forms, and the fine size to which these attained. The richest bed occurs about the middle of the productive Coal Measures, and has altogether a Lower Carboniferous facies, containing *Spirifer bistriatus*, *Productus scabriculus*, *Rhynchonella pleurodon*, *Discina nitida*, *Conularia quadrisulcata*, *Pecten*, two species, *Nucula*, *Nuculana (Leda)*, and several species of *Schizodus* and other bivalves hitherto known as *Sanguinolites*, with several species of Cephalopods and Gasteropods, some of which are of large size.

This fauna, though not exactly identical, has a close resemblance to that of the Redesdale Ironstone, which is generally considered to be about the horizon of the Yoredale beds of Yorkshire; the specific differences are not really greater than might be expected to have obtained in forms surviving through long periods of time, several species being common to the two deposits.

<sup>1</sup> Pal. Soc. volumes for 1894 and 1895, 'Monograph of Carbonicola, Anthracomya, and Naiadites,' pp. 9 and 150.



At the base of the South Wales Coal-field, under the Farewell Rock—not the Millstone Grit of this district, though the name Farewell Rock is used in this sense by the Lancashire miners—is a marine band which also resembles in its fauna the Redesdale Ironstone even more closely than the Pennystone of Coalbrookdale. These beds are known as the “Rosser Veins.” About 40 per cent. of the Brachiopoda and Mollusca are common to the two deposits.

The molluscan fauna of the marine beds in the Ganister series of the Lancashire, Yorkshire, and North Midland Coal Measures differs markedly from those of the marine bands of South Wales and Coalbrookdale, the characteristic Ganister fossils, *Aviculopecten papyraceus* and *Goniatites Listeri* being conspicuously absent. The latter is stated by Salter to occur, however, in the South Wales bed (‘Mem. Geol. Surv.,’ “Iron Ores of South Wales,” p. 221, pl. i, fig. 36), but does not seem to be present at Coalbrookdale.

These interesting recurrences of a fauna characteristic of older rocks in beds of a more recent date cannot but point to the fact that, during the time occupied by the deposit of the intervening rocks, certain species must have survived in some outside area, where a definite set of conditions favorable to their survival obtained, or only altered so gradually that, as the shore rose or sank, those forms for whose existence a certain depth of water was necessary would not feel the change, and would be able to slowly migrate with the varying change of the level of the floor of the sea; while others, more plastic, became modified into new species by accumulated variations in successive generations.

Such an alternation and repetition of conditions, bringing back with them faunas which had once lived, died, and been entombed at the same place, but on a lower level, renders the value of palæontological zones of small moment in the matter of the correlation of the various beds of the same period in different districts; but, on the other hand, reasoning from the bathymetrical distribution of the recent representatives of palæozoic forms, strong evidence of the method and conditions under which the fossiliferous beds were deposited may be deduced. The Carboniferous rocks of Great Britain can have been at no time laid down at any great distance from land. The older rocks of Devon and Cornwall on the south, Middle and North Wales, and the Lake District, and the high lands of Galloway on the west, and due north the Highlands of Scotland, were dry land during the Carboniferous epoch. That these points of high land could not have been isolated islands in the Carboniferous sea is evident from the littoral deposits of slates and sandstones of Devonshire in the south, and the Scoto-Northumbrian area in the north, so well developed along the line of the receding or advancing shores, which must have been the result of surface denudation from large land-areas, and this condition of things would necessitate a large and complicated system of river-drainage. While in the main the general movement during

this time was one of slow depression, this was not by any means constant; periods of intermission, or even of elevation, marked by the growth of the vegetation which formed the coal, must have supervened, and at times even the gradual movements of depression must have been accentuated, causing a retrocession of the shore-line, and the extension of the area of marine deposit, so that the deposition of calcareous ooze was unaffected by the mixture of sediments arising from the denudation of the land. The pureness of the limestone deposit may have been due either to the greater distance from such areas of contamination, or to the existence of Barrier reefs or other submarine ridges which would filter off the suspended matter. Deposition, however, seems to have been always in the end greater than the amount of depression; for even in the most typical areas of marine sediments evidence shows that there was a gradual filling up, the limestones are gradually replaced by shales, with thin-bedded limestones, then shales and sandstones, and finally the terrestrial conditions necessary for the growth of a large and varied flora obtained.

It is not improbable that the Cambrian and Granitic areas of Wexford, Carlow, and Wicklow were continuous with the similar deposits of Wales, and formed a peninsula, washed on the south, north, and west by the Carboniferous sea, on the bottom of which the thick deposits of Irish limestone were accumulating. The Carboniferous succession of Howth, Malahide, and that neighbourhood affords undoubted evidence of the close proximity of land, and represents the beds deposited on the northern shore of this peninsula. Indications of a coast-line can be traced north to Co. Down, where, on the present shore at Holywood, shales with *Modiola Macadamii* occur; similar shales also being found in Londonderry and Tyrone, from where the shore-line probably passed across to the Ayrshire coast. The Cumbrian area of older rocks was probably continuous with those of similar age in the Isle of Man, and perhaps the Mourne Mountains, but this mass must have been separated from the Welsh land by a straight or deep arm of the sea, in which were deposited the limestones of North Wales, extending as far north as the southern part of the Isle of Man. The succession of deposit in the North Wales area is extremely interesting, showing the following sequence, according to Prof. A. H. Green, as quoted by H. B. Woodward, 'Geology of England and Wales,' p. 158:

CARBONIFEROUS	{	Grey limestone,
LIMESTONE.		Thin-bedded earthy limestone,
		Flaggy and sandy limestone;
MILLSTONE GRIT	{	Hard, close-grained sandstones,
AND		Shales,
YOREDALES		Soft fine-grained sandstones,

which is typical of sea gradually becoming shallower.



In a south-easterly direction the Carboniferous sea extended across the whole east and south of England, passing over the Ardennes and North Central Europe to the Urals.

Judging from the presence of similar faunas wherever Carboniferous rocks are explored, it would appear that conditions of climate were fairly equable over the whole of the earth in those times. Indeed, it is questionable whether the differences in the various species described from European, American, and Australian Carboniferous rocks really indicate variations of specific value, and are any greater than might be expected in a single species of very wide distribution.

There is a certain amount of doubt as to the true base of the Carboniferous rocks in the South west of England and Ireland. This question was discussed by Beete Jukes in the 'Memoir of the Geological Survey of Ireland, Explanation of Sheets 187, 195, and 196,' pp. 33—37, who summed up in favour of the Baggy Point, Braunton, Marwood, and Pilton beds of Devonshire, and the Coomhola Grits and Carboniferous Slate of co. Cork, being regarded as belonging to the Carboniferous system, rather than to the Old Red Sandstone, on palæontological grounds.

He says, p. 34, "With the exception of the shells called *Cucullæa* and *Curtonotus*, and a few other fossils which are found almost solely in the grit stones (and which we may suppose, therefore, to have been sand-loving animals), and a few species such as *Modiola Macadami* and *Avicula Damnoniensis*, which are found chiefly in shales or slates (and appear, therefore, to have been inhabitants of muddy bottoms), most of the species found in the Carboniferous Slate are also found in the Carboniferous Limestone. It is true that the limestone has many species which are not found in the grits, or in the shales or slates, but it is obvious that we may attribute this also to the nature of the different sea bottoms." The following Carboniferous fossils occur in the debatable beds:

*Fenestella antiqua.*  
*Athyris ambigua.*  
*Productus scabriculus.*  
*Rhynchonella pleurodon.*

*Spirifera cuspidata.*  
 — *striata.*  
*Streptorhynchus crenistria.*  
*Terebratula hastata.*

Of these he says, they "range throughout the Carboniferous Slate as they do throughout the Carboniferous Limestone, occurring in the grits and slates side by side with the fossils that are peculiar to those beds." Not only, indeed, do fossils which are commonly found in the Carboniferous Limestone occur in the Pilton beds of Devonshire, classed as Upper Devonian, but even in the Lynton Slates, Lower Devonian, *Fenestella antiqua* and *Chonetes Hardrensis*, and in the Ilfracombe beds, Middle Devonian, *Fenestella antiqua*, *Rhynchonella pugnus*, *R. pleurodon*, and *Streptorhynchus crenistria* occur, together with a number of forms not known in

Carboniferous beds. Messrs. Hall, Usher, and H. B. Woodward still retain the term Upper Devonian for the Marwood and Pilton beds. The mere occurrence of a few forms common to other formations does not amount to undoubted evidence for the classification of the two beds under the same system. All that can be affirmed is that there was a gradual sequence between the two formations, deposition going on without any break or unconformity, and that the changes in environment were such that certain forms of life were unaffected by the alteration of conditions. The direct connection of the Devonian and Carboniferous epochs by passage beds is not only evident in Devonshire; passage beds are also found in the Forest of Dean, in Shropshire, as the Farlow beds, in the Lake District, and in the Isle of Man, but in these cases the palæontological evidence is small and unimportant.

From the palæontological point of view of this Monograph the upper limit of the Carboniferous rocks is not important. The upper red beds of the Coal Measures contain a fauna from which molluscan remains are almost entirely absent, with the exception of *Anthracomya Phillipsii* and a few microscopic shells, which have been found in the upper measures at Slade Lane, Manchester, by Mr. Roeder. Doubtless much of the ground in Staffordshire and Warwickshire now mapped as Permian should really, on lithological grounds and from the fossil flora contained in the beds, be more correctly grouped as Upper Carboniferous.

It will have become apparent from the foregoing pages that it is impossible to convey adequate information as to the British Carboniferous rocks in one single classification.

In English text books the succession of Carboniferous rocks in the North Midlands and Yorkshire is generally given as typical of the period. A comparison, however, with the general succession in Scotland, Ireland, and Devonshire will at once show the local character of this classification. The following schemes, with the general sequence in different localities arranged side by side, will give some idea of the very local character of much of the Carboniferous deposits; and it appears to the writer that a twofold classification of Carboniferous rocks would be more accurate than the threefold one that is at present generally in use. But even then there is no accurate line of demarcation between the lower shales and grits of the Millstone Grit series and the upper beds of the Carboniferous Limestone and Yoredale strata. Mr. R. Kidston<sup>1</sup> is, I see, also of this opinion, and his views are based on the distribution of the Carboniferous flora. This classification is as follows:

UPPER CARBONIFEROUS	or	{	Coal Measures.
ANTHRACIFEROUS SERIES			Millstone Grit series.

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<sup>1</sup> 'Proc. Roy. Phys. Soc. Edin.,' vol. xii, 1893-4, p. 222.



	Scotland.	England.
LOWER CARBONIFEROUS or	{ Carboniferous Limestone series	{ Yoredale series.
CALCAREOUS SERIES		
	{ Calciferous Sandstone series	{ Mountain Limestone.
		{ Lower Limestone, shales, &c.

The term Carboniferous limestone Series has been applied to a division of the Carboniferous rocks of Scotland, and therefore cannot be used for the name of the main division, though at the same time it is somewhat of a misnomer to apply the term in this sense, for the words "Carboniferous Limestone" are used to denote in England and Ireland a deposit which differs vastly from that which obtains in Scotland.

#### GENERAL SEQUENCE OF THE CARBONIFEROUS ROCKS OF SCOTLAND.

COAL MEASURES .....	1. Upper or red sandstone group.—Red sandstones, shales, and thin coal.
	2. Lower or black group.—Sandstones, shales, fireclays, and coal seams. Sandstones and lenticular coal seams below. Base the Slaty band ironstones.
	3. Sandstones, shales, fireclays, and lenticular seams of coal. The last series are generally classed as Millstone Grit, but such a division is arbitrary, not founded on a break either in the lithological or in the palæontological sequence.
CARBONIFEROUS LIMESTONE SERIES OF SCOTLAND	Sandstones, shales, limestones, and coals, with the Hosie limestone at the top and the Hurlet limestone as the base.
CALCIFEROUS SANDSTONE SERIES	Cement stone group.—Shaly clays and argillaceous limestones, oil shales, and sandstones; many brackish or fresh-water beds.
	Red sandstone group.—Red and green marls and sandstones.

#### THE CARBONIFEROUS SEQUENCE IN NORTHUMBERLAND.<sup>1</sup>

COAL MEASURES .....	Coal seams with alternating beds of shales, sandstones, and fire-clay down to the base of the Brockwell seam.
GANNISTER AND MILLSTONE GRIT (probable representatives of)	Sandstones, shales, and coals, with <i>Aviculopecten</i> , near Whitton-stall (Lebour); but there is nothing really distinctive of Millstone Grit.
UPPER LIMESTONE SERIES ...	Upper calcareous division. Sandstones and shales with one or more beds of marine limestone and some coals.
	Calcareous division with a base at the bottom of the Redesdale limestone, with many beds of marine limestone, sandstone, shales, and coals.
LOWER LIMESTONE DIVISION	Carbonaceous division.—Limestones and coals.
	Tuedian division.—Massive grits and shales; coals rarely. Lower Tuedian or cement-stone group.—Cement-stone bands passing into limestones; coals very rare; shales and sandstones.

<sup>1</sup> After Tate and Miller, 'Geol. Mag.,' dec. 3, vol. iv, 1887, p. 117; 'Report of Sub-Committee on Classification,' Internat. Geol. Congress, 1888, p. 149.

GENERAL SEQUENCE OF THE CARBONIFEROUS ROCKS OF NORTH STAFFORDSHIRE,  
DERBYSHIRE, SOUTH YORKSHIRE, AND LANCASHIRE.

CARBONIFEROUS LIMESTONE SERIES.	COAL MEASURES.....	{	<i>Red beds</i> , clays, sandstones, then coals; black band ironstones and fresh-water limestones.
			Productive measures. Clays, sandstones, coals, and ironstones. Gannister series with occasional marine beds; gannister rock, shales, clays, and coals.
	MILLSTONE GRIT .....	{	From one to six beds of grits separated by shales, and occasionally a seam or two of coal, having the Shale, Pendle, or Farey's grit as the base.
			Rough Well or first grit.
			Haslingden flags or second grit.
			Chatsworth, Ravelin, Roaches, or third grit.
			Kinderscout or fourth and fifth grit. Pendle, Farey's, or sixth grit.
	{	YOREDALE SERIES	Shales with thin beds of hard close-grained sandstone.
		MOUNTAIN LIMESTONE	Black shales and limestones.
			Carboniferous or Mountain limestone.

## SEQUENCE OF THE CARBONIFEROUS DEPOSITS OF THE MIDLANDS (ENGLAND).

*South Staffordshire.*—The Coal Measures rest directly on Silurian rock.

*Warwickshire Coal-field.*

Coal Measures.—Red beds with spirorbis limestone. Productive measures.

Millstone Grit.—Hard siliceous rock with bands of shale.

Lower Carboniferous absent.

*Coalbrookdale Coal-field.*

Coal Measures.

Millstone Grit.

Carboniferous Limestone.

*Forest of Wyre.*—Coal Measures rest on Old Red Sandstone strata.

*Forest of Dean Coal-field.*

Coal Measures.

Millstone Grit.

Carboniferous Limestone.

*Shrewsbury Coal-field.*

Coal Measures only, resting on Cambrian and Lower Silurian beds.

*Clee Hill Coal-field.*

Coal Measures.

Millstone Grit.

Carboniferous Limestone.

## THE CARBONIFEROUS SEQUENCE IN NORTH WALES.

COAL MEASURES .....	{ Measures with seams of coal; some earthy marine limestones at base.	
MILLSTONE GRIT .....	{ Beds of chert sandstones and conglomerate with intervening shales. Black limestone occasionally arenaceous.	
CARBONIFEROUS LIMESTONE	{ Upper, grey limestone . . . . .	500 feet.
SERIES	{ Middle, white limestone . . . . .	600 „
	{ Lower, brown limestone . . . . .	400 „
BASEMENT BEDS .....	{ Red conglomerates.	

## THE CARBONIFEROUS SEQUENCE OF SOUTH WALES.

COAL MEASURES .....	{ Upper series.	
	{ Pennant series. Sandstones and coals.	
	{ Lower or white ash series. Coals and ironstones.	
MILLSTONE GRIT.....	{ ? Absent.	
CARBONIFEROUS LIMESTONE	{ Gower series { Black shales and sandstones, with a few dark lime-	
SERIES	{ stones . . . . .	1600 feet.
	{ Limestone . . . . .	500 to 2000 „
	{ Lower limestone shales . . . . .	400 „

## CARBONIFEROUS LAMELLIBRANCHIATA.

## THE CARBONIFEROUS SEQUENCE IN IRELAND.

COAL MEASURES.....	{	Upper.	
		Middle.	
	{	Lower.	
		Flagstone series.	
		Shale series, with <i>Aviculopecten papyraceus</i> and <i>Posidonomya Becheri</i> . <sup>1</sup>	
CARBONIFEROUS LIMESTONE SERIES.	{	Upper limestone	Dark earthy limestone, with grey shales and chert.
		Middle limestone	
		Lower limestone.	Pale grey crystalline.
		Lower Carboniferous	{ Sandstone. Shale. Dark shales and thin limestones, and in the south the Carboniferous slate and Coomhola grits.

## THE CARBONIFEROUS SEQUENCE IN SOMERSETSHIRE.

COAL MEASURES.....	Upper	{ Radstock and Farringdon series. New Rock and Vobster series.
MILLSTONE GRIT .....	Sandstones.	1000 feet.
CARBONIFEROUS LIMESTONE SERIES.	{	Upper Carboniferous shales, sandy in character.
		Mountain limestone.
		Lower Carboniferous shales. <sup>2</sup>

## THE CARBONIFEROUS SEQUENCE IN DEVONSHIRE.

CULM SERIES .....	{	Grey grits, slates, and shales. Eggesford type.
		Sandstones, grits, shales, and beds of culm. Morchard type.
		Cherts, shales, and grits. Coddon Hill type.
		Shales with thin grits, dark limestones, and beds of culm. Passing down without any lithological break into Upper Devonian.

## THE CARBONIFEROUS SEQUENCE OF BELGIUM.

COAL MEASURES.	
Transition beds in Namur.	
CARBONIFEROUS LIMESTONE	{ Viséan. Detrital.
	{ Waulsortian. Corallian.
	{ Tournaisian. Crinoidal.

<sup>1</sup> On account of the fauna contained in these beds the writer has included them in the Coal-measure group.

<sup>2</sup> The Lower limestone shales contain many fossils which are also found in the Marwood, Coomhola, and Moyola beds, often classed as Upper Devonian.



## THE CARBONIFEROUS SEQUENCE IN RUSSIA.

The Carboniferous series of Russia is given in the accompanying table, which is quoted from a paper by Mons. Tschernichew in the 'Annales de la Société Géologique du Nord,' tome xvii, 1890, p. 201.

Oural.	Timane.	Centre Russe.
C. { c. Horizon à <i>Spirifer fasiger</i> , <i>Conocardium Uralicum</i> , <i>Schwagerina princeps</i> , &c. B. Horizon à <i>Productus cora</i> , <i>Marginifera Uralica</i> , &c. A. Horizon à <i>Syringopora parallela</i> , <i>Ompalotrochus Whitneyi</i> , <i>Spirifer striatus</i> , &c.	Idem Idem Idem	Idem. Idem. Idem.
B. Calcaire à <i>Spirifer Mosquensis</i> <sup>1</sup>	Idem	Idem.
Calcaire à <i>Productus giganteus</i> , <i>P. striatus</i> , <i>Chonetes papillionacea</i> , &c. <div style="text-align: right;">Dépôts de grés argilleux à <i>Stigmaria</i> <i>ficoides</i>. Couches de calcaires à <i>Productus mesolobus</i> subordonnées.</div>	Manque.	Calcaire à <i>Productus giganteus</i> . Couches Houillères.

The same author goes on to state that he considers his Stage A to represent the Yoredale, Carboniferous Limestone and Calciferous Sandstone beds of Great Britain, while his Stage B is equivalent to the Gannister and Millstone Grit Series, and Stage C to the Upper and Middle Coal-measures. Certainly, from a palæontological point of view, such a comparison of strata, differing widely in its fauna and in lithological characters, seems absurd, and it points to the utter hopelessness of attempting to make the Carboniferous series of widely separated areas conform to subdivisions typical only of a single area in Great Britain. In Russia it is evident that marine conditions persisted steadily through the greater part of Carboniferous time, and that the rate of deposit must have been identical with the rate of depression, consequently the lacustrine and terrestrial conditions necessary for the growth of plants to form the coal only obtained at the commencement of the period.

<sup>1</sup> In the text *Productus corrugatus*, *P. semireticulatus*, *P. longispinus*, *P. scabriculus*, *Rhynchonella pleurodon*, *Athyris ambigua*, *Orthis resupinata*, &c., are said to occur in stage B. These fossils are, however, in Great Britain characteristic of the Mountain Limestone, though some of them do pass up into the Coal-measures of Coalbrookdale and certain Yoredale beds.

## GENERAL SEQUENCE OF CARBONIFEROUS ROCKS IN NORTH AMERICA.

CARBONIFEROUS .....	{	Coal Measures.....	{	Sandstones, shales, conglomerates, and lime-
				stones, with beds of coal and iron ore.
	{	Millstone Grit.....	{	Pebble beds, sandstones, conglomerates, and
				grits.
SUB-CARBONIFEROUS .....	{	Chester Group.....		Limestones in beds, shales, and sandstones.
		St. Louis Group .....	{	Limestones, calcareous shales, and arena-
				ceous limestone.
		Keokuk Group.....		Limestones with chert.
		Burlington Group ...		Limestones with chert.
	{	Kinderhook Group ...	{	Sandstones, grits, and shales, with thin beds
				of oolitic limestone.

## BIBLIOGRAPHICAL SKETCH.

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THE Mollusca of the Carboniferous period have been carefully studied by several authors, some of whom have published extensive works on the subject; four of these, Phillips and M'Coy in Great Britain, and de Ryckholt and de Koninck of Belgium, stand out prominently as standard authorities, and are responsible for by far the greater number of accepted generic and specific names. The extension of biological knowledge, and, above all, the universal acceptance of the Darwinian doctrine of the non-permanence of species, have rendered necessary a review of the work of even these great authorities; and further, the large amount of material accumulated in museums and private collections, has enabled the more fortunate observers of to-day, in a few cases, to place the genera and species in a more satisfactory order on anatomical grounds, not before apparent.

In the following sketch all reference to the Coal-measure genera *Carbonicola*, *Anthracomya*, and *Naiadites* is omitted, a bibliography of these genera having been given in a previous publication (Pal. Soc. vol. for 1894).

1793. I find that the first reference to the fossil Lamellibranchiata of the Carboniferous period is by the Rev. David Ure, in his 'Natural History of Rutherglen,' published in 1793. He refers to two marine forms (p. 310), one of which he calls the "Cockle," (pl. xv, fig. 2); two others (pl. xv, figs. 5 and 6) he regards as two species of the "multi-articulate Cockle," of which he observes, "The hinge, which is observable in casts only, consists of about twelve teeth on each valve." Under this head figures of unmistakable (*Leda*) *Nuculana* and *Nucula* are given. He goes on to say, "Two species of the Muscle are found in Kilbride, figs. 5 and 6, pl. xvi. Specimens of the former are in casts, and are very rare. The latter are in till or ironstone "mostly in single valves." John Gray, in his life of Rev. D. Ure, 1865, gives *Axinus carbonarius*, Portlock, as Ure's "cockle"; *Leda attenuata* and *Nucula gibbosa* as the "multi-articulate cockles";

*Pteronites persulcatus*, M'Coy, and *Myalina*, sp. doubtful, as the two kinds of "muscle."<sup>1</sup>

1809. Nothing further seems to have been noted till W. Martin brought out his 'Petrefacta Derbiensia' in 1809. He refers all fossil forms to living representatives. Only four forms of Lamellibranchs are described in the work:

<i>Conchyliolithus Arcites cancellatus</i>	=	<i>Arca</i> .
" " <i>rostratus</i>	=	<i>Conocardium</i> .
" <i>Pinnites flabelliformis</i>	=	<i>Pinna</i> .
" <i>Mya ovalis</i>	=	<i>Carbonicola ovalis</i> .

1813-18. Very few Carboniferous Lamellibranchs were described or figured by Sowerby in his great work, 'The Mineral Conchology.' The following genera and species are described and figured:

<i>Sanguinolaria gibbosa</i> .	<i>Nucula Palmæ</i> .
<i>Cardium Hibernicum</i> .	<i>Pecten granosus</i> .
— <i>elongatum</i> .	— <i>papyraceus</i> .
<i>Inoceramus vetustus</i> .	— <i>plicatus</i> .
<i>Isocardia oblonga</i> .	

In 1828 Fleming ('Hist. Brit. Anim.') recapitulates, with a short description in each case, those Carboniferous species which had already been described by previous writers, and in some cases (*Mytilus crassus*, *Corbula limosa*) by himself, and at the same time describes most carefully *Hiatella sulcata* and *Corbula limosa* from Carboniferous strata. No figures, however, of the new shells are given. The following species are enumerated:

<i>Sanguinolites gibbosa</i> .	<i>Pinna flabelliformis</i> .
<i>Hiatella sulcata</i> .	<i>Nucula palmæ</i> .
<i>Corbula limosa</i> .	— <i>attenuata</i> .
<i>Cardium alæforme</i> .	— <i>gibbosa</i> .
<i>Isocardia oblonga</i> .	<i>Arca cancellata</i> .
<i>Unio Urei</i> .	— <i>rostrata</i> .
<i>Modiola bipartita</i> . <sup>2</sup>	<i>Pecten dissimilis</i> .
<i>Mytilus crassus</i> .	— <i>papyraceus</i> .

In 1829 Höninghaus published a list of fossils in the Museum of the University of Bonn ('Verzeichniss der dem Museum der Universität Bonn,' Petrefacten-Sammlung), giving the localities whence each species was obtained, but nothing was attempted in the way of description or illustration.

1828. In 'Zeitschrift für Mineralogie,' vol. i, for 1828, H. G. Bronn, on p. 262,

<sup>1</sup> Ure's collection is now in the Museum of the Royal Society of Edinburgh.

<sup>2</sup> The specimens of *M. bipartita* figured by Sowerby in the 'Min. Conch.' are from Parkham Park, Surrey, and therefore not Carboniferous. Sowerby, in his remarks on that species, says that certain shells from Llantrissant, near Cardiff, belong to the same species, but does not figure them. This name, therefore, cannot be used for a Carboniferous shell.



gave the name *Posidonia Becheri* to a certain Coal-measure shell. Later on, in 1835—1837, in his ‘*Lethaea Geognostica*,’ finding that the name *Posidonia* had been given to a genus of plants, he considered it inadmissible for a genus of shells, and substituted the name *Posidomya*, and refigured *P. Becheri*, together with *Pterinea lævis*, *Cardium elongatum*, and *Hippopodium ponderosum*, the last being probably erroneously stated to belong to the Carboniferous strata. In the ‘*Index Palæontologicus*’ of the same author, published in 1848, lists of the known Carboniferous Lamellibranch fossils are given.

In 1836 Professor John Phillips published his great work on the “Mountain Limestone District,” being Part II of ‘*Illustrations of the Geology of Yorkshire*.’ In this volume are described fifty-six species belonging to eighteen genera of Lamellibranchiata from the Carboniferous beds of Derbyshire, Yorkshire, and Northumberland, of which forty-nine species are described and figured as new; but one of these, *Pinna costata*, is said to be “probably the species figured by Martin under the names of *Pinna flabelliformis* and *P. nuda*.”

Many of the type specimens are fortunately preserved in the “Gilbertson Collection” of the Natural History Museum at South Kensington, but a few are in the Museum at York, and others have completely disappeared.<sup>1</sup> Under such circumstances there is great difficulty in arriving at a conclusion as to which shell is supposed to be represented by the figure, owing to the meagre descriptions and the pooriness of the plates; and it would appear that individual figures are often a compound of several views from different aspects of the same shell. This work is of the highest importance in the history of Carboniferous palæontology; previous to its issue only about twenty-three species belonging to fourteen genera of marine Lamellibranchs had been recorded, and the majority of the genera and species are still accepted.

1836. Dr. Rhind, in his ‘*Excursions Illustrative of the Geology and Natural History of Edinburgh*,’ gave a note at p. 143 of the occurrence of “two species of Testacea. One of these is decidedly a *Mytilus*; . . . . the other species resembles the *Mactra subtruncata*” in shale at Woodhall, Water of Leith.

In 1838 the same author, in a little book entitled ‘*The Age of the Earth*,’ gave a plate with four Unios from the Coal-measures of Polmont, and *Axinus Pentlandicus* and a Modioliform shell from Woodhall, Water of Leith, now recognised as a dwarfed form of *Naiadites crassa*.

On February 5th, 1834, Prof. (now Sir) J. Prestwich’s paper on the ‘Faults which affect the Coal-field of Coalbrookdale’ was read before the Geological Society of London, and in the ‘*Proceedings of the Geol. Soc.*,’ vol. ii, p. 20, it is

<sup>1</sup> It is believed that, on Prof. Phillips’s arrival in London by coach, from York on his way to Oxford, one of his boxes of fossils was stolen at the Bell Savage Yard, and the stones, not being of value to the thieves, were thrown over Blackfriars Bridge.

stated that "the author concludes his memoir with some observations on the fossils . . . . of eighteen genera of shells which he enumerates, twelve are marine." A memoir on the 'Geology of Coalbrookdale,' by Joseph Prestwich, jun., "was commenced" on April 13th, 1836, and concluded on the 27th, 'Proceed. Geol. Soc.,' vol. ii, p. 401. At p. 405 it is stated that "The fossils of the Coal-measures are described with great detail." The paper was not published in the 'Transactions' of the Society till 1840, when there appeared an Appendix by Mr. J. de Carle Sowerby, describing and figuring the eighteen genera of shells before mentioned.

Although probably determined in 1834 and 1836, these fossils can be recorded as named only in 1840, according to the rules of nomenclature. There are twenty species of various genera of Carboniferous Lamellibranchs described in the paper; though, with possibly only two exceptions, the names given to the eight genera therein enumerated can no longer stand on biological grounds. The following marine Lamellibranchs are described and figured :

<i>Unio Urei.</i>		<i>Nucula æqualis.</i>
— <i>Ansticei.</i>		— <i>accipiens.</i>
— <i>parallelus.</i>		— <i>acuta.</i>
<i>Donax? sulcata.</i>		<i>Pecten gentilis.</i>
<i>Venus? carbonaria.</i>		— <i>scalaris.</i> <sup>1</sup>

During the years 1834—1840 Goldfuss issued, in parts, his great work, 'Petrefacta Germanica.' Unfortunately, though he gives with care the localities whence his types were obtained, it is often very difficult to ascertain from which particular geological formation they were collected. The collection of types is now in the Museum of the University of Bonn. As far as I can make out, about one dozen new Carboniferous Lamellibranchs are figured and described, but several of those of other authors are refigured from German examples.

1840. Sedgwick and Murchison's paper "On the Physical Structure of Devonshire, and on the Subdivisions and Geological Relations of its Older Stratified Deposits," was read before the Geological Society on June 14th, 1837, and was published in the 'Transactions of the Geological Society,' vol. v, pt. iii, 1840. It contains six plates of fossils, with descriptions by J. de Carle Sowerby; the following Lamellibranchs being figured and described :

<i>Posidonia lateralis</i>		
— <i>Bècheri</i> , Goldfuss	}	From Venn, near Barnstaple.
— — var. Goldfuss		
— <i>tuberculata</i>		From Budle, Northumberland.

<sup>1</sup> Some other species, referred to *Modiola*, *Mytilus*, and *Avicula*, have been determined as *Naiadites* in my previous monograph.

<i>Pulastra ? antiqua</i>	} Some from Marwood Quarry ; all from the Barn- staple and Petherwin Group.
<i>Cardium aliforme</i>	
<i>Cucullæa unilaterialis</i>	
— <i>trapezium</i>	
— <i>angusta</i>	
— <i>Hardingii</i>	
<i>Avicula Damnoniensis</i>	
— <i>subradiata</i>	
— <i>pectinoides</i>	
<i>Pecten nexites</i>	
— <i>transversus</i>	
— <i>plicatus</i>	
— <i>arenosus</i>	

1840. Eichwald's paper, "Die Thier-und Pflanzenreste des alten rothen Sandsteins und Bergkalks in Novogrodschen Gouvernement," was published in the 'Bull. scient. Acad. Imp. Sci. St. Petersburg,' t. vii, 1840. He enumerates the following Carboniferous bivalves :

<i>Nucula cardiiformis.</i>	<i>Unio (Sanguinolaria) sulcatus</i> , Phill.
<i>Cardium exiguum.</i>	— — <i>lævis.</i>
<i>Pterinea lævis</i> (Bronn).	Casts of a shell like either <i>Pholadomya</i>
<i>Pecten tenuissimus.</i>	or <i>Solen.</i>
— <i>Noæ.</i>	

No plates are given, but a short description of each species.

In another publication, 'Die Urwelt Russlands durch Abbildungen erläutert,' the first part of which is dated in the same year, figures and descriptions are given of *Anodonta tenera*, *A. tenuissima*, and *Mytilus fragilis*. The last has deep concentric hollows, reminding the observer of *Posidomomya vetusta*, Sow. But Eichwald does not appear very certain as to the real nature of the shell, for he says, "Sie steht allerdings dem *Mytilus* oder der *Modiola* zunächst, Könnte aber doch zu einer andern Gattung, vielleicht gar zu *Anodonta* gehören, wenn sie vollständiger bekannt wäre die Zeichnung ist nur entworfen, um auf ihre allgemeine Form aufmerksam zu machen."

In a still later publication, 'Bull. Soc. Nat. Moscou,' 1856, p. 565, he thinks his *M. fragilis* identical with *M. Teplowii* (*sic*), de Vern., 'Paléont. de Russie.'

1841. In the first volume of the 'Transactions of the Manchester Geological Society,' 1841, is published Captain Thomas Brown's paper entitled "Description of some New Species of Fossil Shells, found chiefly in the Vale of Todmorden, Yorkshire," with a plate of seventy-eight figures, fourteen of which are those of Lamellibranchs. Six of these forms are referred to *Catillus*, and should now be referred to *Posidoniella*, de Koninck. The shells were all collected by Mr. Gibson of Hebden Bridge, in whose cabinet they are stated to be.



The following shells are described and figured :

<i>Avicula obliqua.</i>	<i>Catillus Kellyi.</i>
— <i>Samuelsii.</i>	<i>Gervillia minor.</i>
<i>Catillus Kirkmani.</i>	<i>Modiola Moorei.</i>
— <i>lævis.</i>	— <i>minuta.</i>
— <i>costatus.</i>	<i>Cytherea antiqua.</i>
— <i>obliquatus.</i>	<i>Artemis parva.</i>
— <i>minutus.</i>	<i>Lucina dubia.</i>

In 1841 another work by Prof. John Phillips, entitled ‘Figures and Descriptions of the Palæozoic Fossils of Cornwall, Devon, and West Somerset,’ was issued by the Geological Survey ; but the bulk of the book is on Devonian remains, and I can only make out that three species of *Posidonia*—*P. tuberculata*, *P. Becheri*, *P. lateralis*—and two doubtful forms referred to *Sanguinolaria*—*S. sulcata* and *S. subelliptica*—are from Carboniferous strata.

In 1842 Agassiz published a translation of Sowerby’s ‘Mineral Conchology,’ but I have not been able to get access to a copy, and am not aware whether any additions or alterations were made therein.

In 1842 de Koninck published the first of his two important monographs on the fauna of the Carboniferous period of Belgium, entitled ‘Description des Animaux Fossiles du Terrain Carbonifère de la Belgique.’ He figures and describes eighty-one species of Lamellibranchiata, many of which were new, belonging to sixteen genear. Reference appears to have been made to every published work bearing on the subject, and several of the generic references of previous authors are corrected. Fifty-one species and three genera are described as new ; the new genera being *Myalina*, *Edmondia*, and *Cardiomorpha*, all of which are still retained.

In 1842 Sir Richard Griffith issued a “Notice respecting the Fossils of the Mountain Limestone of Ireland, as compared with those of Great Britain, and also with the Devonian System.” The paper contains a brief account of the lithological character of the beds included under the term Mountain Limestone, and a table of the fossils showing the strata in which they occur in each of the three Carboniferous Limestone districts of Ireland (Southern, Middle, and Northern districts), contrasted with the occurrence of the same species in North Devon and the British Mountain Limestone of England and Scotland.

1842. D’Orbigny, in his ‘Voyage dans l’Amérique Méridionale,’ tom. iii, 4me partie, 1842, described amongst others two new shells, *Pecten Paredesii* and *Trigonia antiqua* from beds of Carboniferous age in Bolivia.

In the same year John Morris published a ‘Catalogue of British Fossils,’ enumerating all forms described from British strata to date. A second edition appeared in 1854, with additions.



1843. J. E. Portlock's 'Report on the Geology of the County of Londonderry, and of Parts of Tyrone and Fermanagh,' was published by the Geological Survey in 1843. There is a descriptive list of Carboniferous fossils, which are well figured. Mention is made of forty-two species and two varieties belonging to twenty-one genera, twenty species and two varieties being described for the first time; but they are all referred to well-established genera, though subsequent investigation shows such reference to be not always biologically correct.

1843. It is possible that the shells figured by Captain Brown in the 'Ann. and Mag. of Nat. Hist.,' vol. xii, 1843, pp. 390 and 396, under the names *Pachyodon Gerardi* and *P. pyramidatus*, really belong to *Schizodus*; but, as all the types have disappeared, this reference founded on the appearance of the figures alone is uncertain.

In 1844 a letter to the editor of the 'Annals and Magazine of Natural History' from Professor King appeared in that periodical, informing him that he had been "compelled to institute six new genera," in a 'Monograph of the Invertebrate Fossils of the Magnesian Limestone of the County of Durham,' "namely, *Allorisma* for *Sanguinolaria sulcata*, Phillips . . . . *Schizodus* for the Permian and Carboniferous *Axinus*."

1844. The new genera and species by Sir R. Griffith were named and figured by F. M'Coy in his great work entitled 'A Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland;' but the list of names in Griffith's, 'Notice' is somewhat different from that in the Synopsis; in some cases the generic name is changed, and in others the specific; and in addition the names of fossils obtained from the Petherwin and other beds of North Devon are included in the former list.

One genus (*Pteronites*) and sixty-one species in the list are marked as new, all of which were subsequently described and figured.

'The Synopsis of the Characters of the Carboniferous Limestone Fossils of Ireland,' by M'Coy, is the standard book of reference on British Carboniferous Limestone fossils. One hundred and ninety-five species belonging to forty-eight genera of Lamellibranchiata, six of which are new, are figured and described; in addition descriptions are also given of those forms occurring in Ireland, which had been previously published. One curious point is to be noted in the plates, and that is that the drawings have not been reversed on the stone, consequently the opposite valve is depicted to that which is apparently shown. Many of the types are in the "Griffiths Collection" of the Museum of Science and Art, Dublin, but unfortunately those which were in private collections have been lost sight of.

1844. Dr. Garner brought out his 'Natural History of Staffordshire' in 1844; on plate B he gives figures of *Pecten ellipticus* (interior), *Inoceramus vetustus*, and *Pleuro-*

*rhynchus minax*. In an appendix issued in 1860 are fuller lists of Carboniferous Lamellibranchs from the county of Staffordshire.

1845. Morris furnished the chapter on the "Fossil Mollusca of New South Wales and Van Diemen's Land" in Strzelecki's 'Physical Description of New South Wales and Van Diemen's Land,' published in 1845. He enumerates and figures the following species from rocks of supposed Carboniferous age:

*Allorisma curvata*.

*Pachydomus cordatus*, new genus = *Megadesmus*, Sow., name previously occupied.

*Pachydomus antiquatus*.

— *cuneatus*.

— *lævis*.

— *globosus*.

— *carinatus*.

*Orthonota? costata*.

— *compressa*.

*Eurydesma*, new genus.

*Pterinea macroptera*.

*Pecten Illawarensis*.

— *limæformis*.

— *Fittoni*.

— *squamuliferus*.

In 1845 Murchison, de Verneuil, and de Keyserling brought out 'Le Géologie de la Russie d'Europe,' in which several Carboniferous Lamellibrancha are figured and described; fourteen species belonging to nine genera are said to be new, namely:

*Pecten ellipticus*.

— *sub-fimbriatus*.

— *Sibericus*.

— *Bouei*.

— *Valdaicus*.

*Avicula sub-papyracea*.

*Mytilus Teplofi*.

*Mytilus Pallasi*.

*Pinna Ivaniskiana*.

*Schizodus Rossicus*.

*Unio Eichwaldianus*.

*Cardium Ouralicum*.

*Sanguinolaria Römeri*.

*Solemya Biarmica*.

In 1846 de Keyserling published his 'Petschoraland,' with figures and descriptions of four Carboniferous bivalves, only one of which, *Pecten subclathratus*, was new.

De Ryckholt's 'Mélanges paléontologiques,' the first part of which is dated 1850, and the second part 1853, seems to be the next important work on Carboniferous Mollusca to appear. The names of the new species are all dated, and vary from 1847 to 1853. Fortunately there will not arise any question of precedence of names on this account, for few publications on the subject appeared about this time. In Part I thirty-six new species and one new genus (*Pholadomya*) of Carboniferous Lamellibranchiata are figured, the description of the latter being found in Part II, where fifty-six new species and three new genera of bivalves—*Anomianella*, *Scaldia*, *Omalia*—from Carboniferous beds are defined and depicted. The figures seem to have been somewhat idealistic when compared with those of the same specimens published in de Koninck's great work.

1846. In the 'Bulletin de la Société Géologique de France,' tom. iii, 1846, de Verneuil gives a list of fossils from the Carboniferous beds of Asturias collected by Paillette. No new species are described and no figures are given. The lists contain the following Lamellibranchs from the Terrain carbonifère, de Pola de Lena :

*Cardium* voisin du *C. rostratum*, de Kon. (*C. elongatum*, Sow.).  
*Nucula tumida*, Phill.

1847. A paper by M'Coy, "On the Fossil Botany and Zoology of the Rocks associated with the Coal of Australia," appeared in the 'Annals and Magazine of Natural History,' vol. xx, for 1847, p. 298, *et seq.*, the following new Lamellibranchs are described, good figures being also given :

*Pecten ptychotis.*  
 — *sub-quinquelineatus.*  
*Inoceramus Mitchellii.*  
*Pleurorhynchus australis.*  
*Modiola crassissima.*  
*Pachydomus gigas.*  
 — *sacculus.*  
 — *ovalis.*

*Pachydomus pusillus.*  
*Cardiania exilis.*  
*Notomya* (new genus).  
 — *securiformis.*  
 — *clavata.*  
*Pullastra?* *striatocostata.*  
*Venus?* *gregaria.*

1849. In the memoir of the United States Exploring Expedition of 1849 Prof. Dana published the figures and descriptions of a numerous suite of fossils from beds of Carboniferous age in New South Wales, amongst which were many forms of Lamellibranchiata. None of the shells are recognised as belonging to British or European forms. The work previously done by Morris and M'Coy is acknowledged by the author, who from the text appears to have also previously published some account of fossils from South Australia. The new genera *Astartilia* and *Maeonia*, with its allied groups *Pyramia* and *Cleobis*, are defined, and the genus *Pachydomus* of Morris is accepted.

1849. In the 'Monograph of Permian Fossils of England,' by King, published as the volume for 1849 by the Palæontographical Society, the new generic name *Allorisma*<sup>1</sup> is given to include shells hitherto known as *Myacites*, *Schlotheim*, *Hiatella*, *Fleming*, *Sanguinolaris*, *J. de C. Sowerby*, *Unio*, *id.*, *Lutraria*, *Goldfuss*, *Pholadomya*, *Morton*, *Sanguinolites* (pars), *M'Coy*, and *Orthonota* (pars), *Salter*. This genus was supposed to possess a sinus in the pallial impression, and the original of the specimen figured, which is in the Museum at Newcastle-on-Tyne, has a fine pallial sinus in ink. This character is denied by M'Coy, and is certainly absent in all the shells from Redesdale which show the interior as a cast. It is probable that some markings due to other causes were mistaken for the sinus,

<sup>1</sup> There is evidently a misprint in the name on the page giving the explanation of pl. xi (op. supra cit.), where it occurs as *Allerisma*.



and it is impossible now to judge from the original specimen, as the pen which gave that specimen the sinus has probably left scratches in the supposed situation.

In the same volume the genus *Edmondia*, *de Koninck*, is re-defined, and some internal characters of that genus described and figured, the type taken being from the Redesdale Ironstone beds of Lower Carboniferous age. Other than these two cases no further mention is made in the work of Carboniferous remains.

In 1849 Captain Thomas Brown issued his 'Atlas of the Fossil Conchology of Great Britain and Ireland,' a work in which were reproduced the figures of all the fossil Mollusca hitherto published in Great Britain. Several new Lamellibranchs from the Coal-measures are described in the volume, but curiously enough none of M'Coy's new genera or species seem to have been known to the author. A brief description and the locality of each fossil are also given. The publishers brought out a reproduction of the plates of this work with a much abbreviated letterpress in 1889, and, unfortunately, adopted none of the revised generic names which had come into vogue in the interval between the editions. The plates are, however, from the same steel plates, and are therefore identical with those of the original.

1850. D'Orbigny's 'Prodrome de Paléontologie' bears the date 1850, but all species given on his authority are dated 1847. 282 species of Lamellibranchs from Carboniferous strata belonging to nineteen genera are enumerated with reference to the author of each and the locality where it occurs.

1851. In the 'Annals and Magazine of Natural History' for the year, sec. ii, vol. vii, p. 157, is a paper by M'Coy entitled "Description of some New Mountain Limestone Fossils," with a full account of his new genera, *Streblopteria* and *Aviculopecten*, and a figure of the internal cast of a member of the latter; and two years later, in 1853, in the same serial is another paper, "On some New Carboniferous Limestone Fossils," with descriptions of four new shells. This description was literally repeated with figures in that author's greater work published in 1854-6 in conjunction with Adam Sedgwick, entitled 'British Palæozoic Fossils.' This is a great work, containing much new matter as to classification, several new orders and families being defined, and many old families, genera, and species being re-described. Figures are given of the New Carboniferous fossils described in the 'Annals and Magazine of Natural History' for 1851, just quoted, together with others,—in all twenty species belonging to seven genera; but no new form is described in the work.

In the plates to this volume the lithographer has not reversed the drawings on the stone, so that the opposite valve is apparently shown to that from which the drawing was made.

The following genera and species are figured :



<i>Lithodomus Jenkinsoni.</i>	<i>Aviculopecten segregatus.</i>
<i>Solemya primæva.</i>	— <i>concavus.</i>
<i>Sanguinolites subcarinatus.</i>	— <i>cancellatulus.</i>
— ( <i>Leptodomus</i> ) <i>costellatus.</i>	— <i>Ruthveni.</i>
— <i>variabilis.</i>	— <i>cælatus.</i>
— <i>iridinoides.</i>	— <i>docens.</i>
— <i>clava.</i>	— <i>planoradiatus.</i>
<i>Edmondia rudis.</i>	<i>Pinna spatula.</i>
— <i>scalaris.</i>	— <i>flexicostata.</i>
— <i>oblonga.</i>	<i>Pteronites persulcatus.</i>

1853. In a paper "On some New Molluscs in the Carboniferous Slates of the Anthracite Seams of the Wilkestarre Coal Formation," published in the 'Journal of the Academy of Natural Sciences of Philadelphia,' vol. ii, pl. iii, January, 1853, Isaac Lea described and figured :

<i>Modiola Wyomengensis</i>	} ? <i>Naidites.</i>
— <i>Minor</i>	
<i>Posidinia</i> ? <i>Cluthiata.</i>	
— <i>perstuat.</i>	
— <i>distans.</i>	

In the "Dritter Band" of Dunker and von Meyers' 'Palæontographica,' dated 1854, are two papers by Friedrich Adolph Roemer under the title "Beiträge zur geologischen Kenntniss des nordweslichen Harzgebirges," the first of which is indexed as being contained in "erste Lieferung," September, 1850 ; the second in the "zweite Lieferung," August, 1852.

A table is given in the second paper of the fossils of the Ibergerkalk, Goniaticalk, and Cypridenen Schiefer, and the Kulm, in which are the names of twenty-eight species belonging to twelve genera of Lamellibranchiata, twelve of which species are said to be new, but several of the other names are not set down to any author.

The following tabular list of genera and species is given on pp. 106, 107, which, however, does not quite correspond with the species mentioned in the text.

...	Iberger Kalk	Goniatitenkalk u. Cypridinen, <i>Schiefer</i>	Kulm.
Pecten	...	...	perobliquus, grandævus, <i>Goldf.</i> ; aurilævis, subradiatus. uniplicata.
"			
Avicula	Wurmii	lævis	Becheri, <i>Goldf.</i>
Posidonomya	...	venusta	carbonaria. <sup>1</sup>
"		striato-sulcata	lepida, <i>Goldf.</i>
Pterinea	crinita, concentrica	amygdaloides	inconspicua, <i>Phil.</i>
Mytilus	intumescens	...	
Conocardium	trapezoidale	...	
(Pleurorhynchus)	aliforme clathratum, <i>Goldf.</i>		
Cardium	lentiforme	concentricum, v. B. <sup>2</sup>	
"		retrostriatum, v. B. <sup>3</sup>	
Cardiola	concentrica	anguliferum	
Lucina	sinuosa		
Cypricardia	elongata		
Venus	subglobosa		
Cardita	...		haliotidea.

Bronn and Römer's 'Lethæa Geognostica' was published during the years 1851—1856, containing figures and descriptions of the genus *Posidonomya*, Bronn, with *P. Becheri*; and three other forms which were, however, not new, namely, *Pterinea lævis*, Goldfuss, and *Conocardium aliforme*, *Conocardium hibernicum*, Sowerby.

1855. In Part II of the 'Report of the Geological Survey of Missouri,' issued in 1885, Shumard describes and figures two new species of Carboniferous Pectenidæ, *P. Missouriensis* and *P. occidentalis*, and one species of Myalina, *M. subquadrata*, while *Allorisma Hannibalensis* is described in a note on p. 206.

In the volume for 1856 of the 'Bulletin de la Société impériale des Naturalistes de Moscow,' tome xxix, 2e partie, is a paper by Eichwald, entitled "Beitrag zur geographischen Verbreitung der fossilen Thiere Russlands (alte Periode)," the following Carboniferous Lamellibranchs being described in it as new:

*Pecten megalotus*.

— *midas*.

*Posidonomya marginalis*.

— *jallax*, afterwards referred  
to *Avicula*.

*Avicula nana*.

*Modiolopsis conspicua*.

*Nucula exigua*.

*Nucula carbonaria*.

*Schizodus sulcifi*.

— *eximius*.

*Astarte socialis*.

*Cardiomorpha distincta*.

— *striata*.

*Cardinia concentrica*.

*Pholadomya connivens*.

<sup>1</sup> *Inoceramus carbonarius* in the text.

<sup>2</sup> ? *Cardium pectunculoides* in the text.

<sup>3</sup> ? *Cardium palmatum*, Goldf., in the text.

The pagination does not, however, always agree with that given by the same author in his 'Lethæa Rossica,' p. 555, equalling p. 120.

1856. In the 'Manual of the Mollusca,' S. P. Woodward assigns to each family and genus of Carboniferous Lamellibranchs, published up to date, its systematic position in the Mollusca, and where the genus is not known from other formations gives a typical figure. In the appendix by Ralph Tate published 1880 various additions and alterations are made.

1857. In the "Palæontological Report" in the 'Third Report of the Geological Survey of Kentucky,' issued 1857, Cox describes and figures the following Lamellibranchs from the Carboniferous beds of that State :

*Pecten Providencesis.*  
*Arca carbonaria.*  
*Gervillia longispina.*  
*Myalina pernaformis.*

*Cardinia ? fragilis.*  
*Avicula rectalateraria.*  
 — *acosta.*  
*Solemya soleniformis.*

In 1858 F. Shumard, in conjunction with G. C. Swallow, read a paper in March, 1858, entitled "Descriptions of New Fossils from the Coal-measures of Missouri and Kansas, which was published in the 'Transactions of the Academy of Science of St. Louis,' vol. i, p. 159, 1856—1860.

The following Lamellibranchs are described, but no figures are given :

*Cypricardia plicatula.*  
*Isocardia ? curta.*  
*Cardium ? Lexingtonensis.*  
*Cardiomorpha Missouriensis.*  
*Leptodomus granosus.*  
 — *Topekaensis.*  
*Solemya recurvata.*  
*Arca cuspidata.*  
*Edmondia Hawnii.*  
*Allorisma cuneata.*

*Allorisma lata.*  
*Avicula semielliptica.*  
 — *Shawneensis.*  
*Mytilus Ottawaensis.*  
 — *tenuiradiatus.*  
*Myalina recta.*  
 — *Kansasensis.*  
*Pecten aviculatus.*  
*Pinna peracuta.*  
*Lima retifera.*

In the same year R. P. Stevens' paper, "Description of New Carboniferous Fossils from the Appalachian, Illinois, and Michigan Coal-fields," appeared in vol. xxv of the 'American Journal of Science.' No figures are unfortunately given. The new species described are—

*Pecten carboniferus.*  
*Leda bellistriata.*  
 — *densmamillata.*  
 — *nuculæformis.*  
 — *pandoræformis.*

*Nucula Houghtoni.*  
*Avicula orbiculus.*  
 — *triplistriata.*  
*Posidonomya striata.*  
 — *auriculata.*

In the Report of the British Association for 1857 is a list of Carboniferous fossils from Ireland by W. H. Bailey.

1858. A paper entitled "Remarks on the Lower Cretaceous Beds of Kansas and Nebraska, together with some New Species of Carboniferous Fossils from the Valley of the Kansas River," by Messrs. Meek and Hayden, was published in the 'Proceedings' of the Academy of Natural Science of Philadelphia for 1858. The following new species are described:

*Axinus (Schizodus) ovatus.*  
*Allorisma? altirostrata.*  
 — *subcuneata.*

*Allorisma? Leavensworthensis.*  
 — *? Cooperi.*

(Vide 'Palæontology of the Upper Missouri,' *infra*.)

In the 'Report on the Geological Survey of Iowa,' vol. i, part ii, Palæontology, 1858, James Hall figures and describes the following species from the Coal-measures and a new genus—*Astartella*:

*Astartella vera.*  
*Dolabra? alpina.*  
*Edmondia? radiata.*

*Nucula ventricosa.*  
*Leda bellistriata*, Stevens.

1859. McChesney issued a small work, entitled 'Descriptions of New Species of Fossils from the Palæozoic Rocks of the Western States,' in 1859. The volume appears to be an extract from the 'Transactions of the Chicago Academy of Science,' vol. i. The following Carboniferous Lamellibranchs are referred to:<sup>1</sup>

*Allorisma sinuata.*  
 — *clavata.*  
*Astartella varica.*  
*Leda gibbosa.*  
 — *Oweni.*

*Leda polita.*  
*Nucula parva.*  
 — *cylindrica.*  
*Edmondia concentrica.*  
*Myalina Swallovi.*

1859-60. In the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' for 1859, published 1860, W. M. Gabb, in a short paper, "Description of Two New Species of Carboniferous Fossils brought from Fort Belknap, Texas, by Dr. Morrey, describes *Myalina deltoidea* and *Posidonia Moorei*.

1860. The *Lethæa Rossica* of Eichwald came out in parts between the years 1853 and 1869. The portion containing descriptions of Carboniferous remains, being the 2nd and 3rd parts of the 'Periode ancienne,' is dated 1860. A few new species are described and figured in this work, with drawings of many of this author's species previously published in the 'Bulletin Soc. Nat. de Moscow,' and other works mentioned above.

<sup>1</sup> Bigsby quotes, *Pinna Adamsii*, *Astartella concentrica*, and *Leda Knoxensis* from Carboniferous beds, as described by McChesney, but I cannot find the publication.



The following genera and species are described as new from Carboniferous beds :

*Avicula pristina.*

*Pterinea hyperborea.*

*Arca exigua.*

*Nucula carbonaria.*

*Astarte socialis.*

1860. The Rev. Thomas Brown read a paper entitled "Notes on the Mountain Limestone and Lower Carboniferous Rocks of the Fifeshire Coast from Burntisland to St. Andrews," before the Royal Society of Edinburgh, subsequently published in vol. xxii of the 'Transactions' at p. 385.

Lists of fossils are given from the Limestone beds described, and three figures are given of a "strong handsome Schizodus" from drawings furnished by Mr. Salter.<sup>1</sup> It is stated that Fleming thought this shell was identical with *Anatina attenuata*, M'Coy. They occur in countless masses in a bed south-east of Kingsbarns, and from near Colinton.

1860. In the Palæontological Notes, p. 11, by Mr. Bailey in the 'Geological Survey Memoir,' "Explanation of sheet 143, Ireland, illustrating parts of the counties of Clare, Kerry, and Limerick," 1860, a figure is given of a new shell, *Myalina Foynesiana*, which occurs with *Aviculopecten* and *Posidonomya*, but no description appears. At p. 19 in the same memoir, figures and description of another new shell, *Lunulacardium Footii*, from basal shales of the Coal Measures of Rosscliff, co. Clare, are given. In 1862 the same author in the Palæontological Notes of the Memoir explaining sheet 127, illustrating portion of Queen's County, figures at p. 9 (figs. 2 a—e), *Leda attenuata*, *Sanguinolites plicatus*, *Solenopsis pelagicus*, from the Lower Limestone shale of Ballyduff River, Bunnow, King's County.

Numerous lists of localities and fossils are given in other Memoirs of the Irish Survey by the same author, but no new species are described.

1860. On July 20th, 1860, G. C. Swallow read a paper before the Academy of Science of St. Louis, subsequently published in vol. i of the 'Transactions,' p. 635, entitled "Description of New Fossils from the Carboniferous and Devonian Rocks of Missouri," in which the following species of Carboniferous Lamellibranchs are described, but not figured :

*Edmondia Marionensis.*

*Cardiomorpha? triangulata.*

*Cardinia occidentalis.*

*Solen Missouriensis.*

*Allorisma ensiformis.*

*Pecten Hallii.*

In the 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1860, p. 496, Messrs. Meek and Worthen published a paper under the title "Descriptions of New Carboniferous Fossils from Illinois and other Western

<sup>1</sup> This shell subsequently received the name *Schizodus Salteri* at the hands of Mr. R. Ethridge, jun.

States," in which are described the following genera and species of Lamellibranchs, but no plates are given :

<i>Aviculopecten Coxanus.</i>	<i>Pecten tenuilineatus.</i>
— <i>pellucidus.</i>	<i>Myalina recurvirostris.</i>
— <i>Koninckii.</i>	— <i>concentrica.</i>
— <i>interlineatus.</i>	— <i>angulata.</i>
— <i>Oweni.</i>	<i>Solemya radiata.</i>
— <i>amplus.</i>	<i>Yoldia ? levistriata.</i>
— <i>oblongus.</i>	<i>Cardiomorpha radiata.</i>
— <i>Burlingtonensis.</i>	

In 1861 appeared the first edition of Hull's 'Coal-fields of Great Britain,' which contained a plate on which was a figure of *Aviculopecten papyraceus*; and later editions with a somewhat altered plate appeared in 1873 and 1881.

In 1861, in the Memoir of the Geological Survey, "Iron Ores of Great Britain," pt. iii, "The Iron Ores of South Wales," Mr. Salter gives a plate with figures of *Schizodus carbonarius*, *Edmondia unioniformis*, and *Myacites sulcata* from the Rosser veins, and a short list of other marine Lamellibranchs from the same horizon. This number contains the original description of that author's genus *Anthracomya*, and illustrations of *Anthracosia* (*Carbonicola*) and *Anthracopectera* (*Naiadites*).

The next year, in the Geological Survey Memoir, 'The Geology of the Country round Wigan,' with the definitions of the new genus *Anthracopectera*, and a figure of *Anthracosia* (*Carbonicola*) *robusta*, Mr. Salter gives a figure of *Posidonia Gibsoni*, Brown. The generic reference is doubted, and it is stated that "a new generic name will in all probability be required."

In 1864, in the Memoir 'On the Geology of the Country round Oldham,' the same writer figures *Aviculopecten papyraceus*, *A. fibrillosus*, n. sp., and *Ctenodonta*, sp. indet., from concretions in shales about 150 yards over the Great Mine Coal, Ashton-under-Lyme.

1862. In John Sleight's 'Ancient History of Leek' is a section "On the Geology of the Neighbourhood of Leek," by Thomas Wardle, F.G.S., with lists of Lamellibranchiata found in the Carboniferous beds of that district. A plate is given with illustrations of eleven genera and species from the Mountain Limestone, and on another plate two genera from the Coal-measures. Nothing new is figured or described.

This list, somewhat revised by Mr. R. Etheridge, was reprinted in the appendix to the Geological Survey Memoir, 'The Geology of the Country round Stockport, Macclesfield, Congleton, and Leek,' in 1866.

1862. Winchell's paper, "Description of Fossils from the Marshall and Huron groups of Michigan," was published in the 'Proceedings of the Academy of

Natural Sciences of Philadelphia' for 1862, pp. 405, &c. The following new forms were described, but unfortunately no figures were given :

*Myalina Michiganensis*.  
 — *umbricaria*.  
 — *aviculoides*.  
 — *pterineseformis*.  
*Pterinea cardinata*.  
*Mytilus Whitfieldianus*.  
*Cardinia complanata*.  
 — *æquimarginalis*.  
 — *concentrica*.  
*Edmondia binumbonata*.  
*Orthonota rectidorsalis*.  
*Sanguinolites unioniformis*.  
 — *Marshallensis*.  
 — *borealis*.  
*Leptodomus clavatus*.  
*Cardiomorpha modiolaris*.  
 — *Julia*.  
 — *capuloides*.  
*Cardiposis crenistriata*.

*Cardiopsis jejuna*.  
 — *megambonata*.  
*Nucula Hubbardi*.  
 — *Iowensis*.  
 — *sectoralis*.  
 — *stella*.  
*Leda bellistriata*, Stevens.  
*Cardium Napoleonse*.  
*Conocardium ? bovipedale*.  
*Posidonomya Romeringeri*.  
 — *Whiteana*.  
 — *mesambonata*.  
*Sanguinolaria similis*.  
 — *septentrionalis*.  
 — *sectoralis*.  
*Solen scalpriformis*.  
 — *quadrangularis*.  
 — *priscus*.

1863. In the same publication for 1863 is another paper by A. Winchell, "Description of Fossils from the Yellow Sandstone lying beneath the 'Burlington Limestone,' at Burlington, Iowa," pp. 2, &c. No figures are given, but the following Lamellibranchs are described :

*Aviculopecten Caroli*.  
 — *occidentalis*.  
 — *tenuicostus*.  
*Posidonomya ? ambigua*.  
*Dexiobia* (new genus) *Whitei*.  
 — *Halli*.  
*Mytilus Whitfieldianus*.  
*Orthonota phaselia*.  
*Edmondia nitida*.  
 — *nuptialis*.  
 — *strigillata*.  
 — *æquimarginalis*.  
 — ? *bicarinata*.  
 — ? *elliptica*.

*Sanguinolites amygdalinus*.  
 — *cylindricus*.  
 — *Iowensis*.  
 — *sulciferus*.  
 — ? *jejunus*.  
*Cardiomorpha trigonalis*.  
*Arca modesta*.  
*Macrodon cochlearis*.  
*Nucula microdonta*.  
*Leda saccata*.  
*Isocardia ? Jennæ*.  
*Cardiopsis megambonata*.  
*Sanguinolaria ? leptogaster*.

1863. Mr. Robert H. Scott read a paper on June 10th, 1863, published in vol. x of the 'Journal of the Geological Society of Dublin,' "On the Fossils of



the Yellow Sandstone of Mountcharles, Co. Donegal," p. 107, with a plate (pl. viii), in which *Cucullæa Griffithii* and *Avicula Damnoniensis* are figured.

These beds are considered by the author to be of Lower Carboniferous age.

1864. The Explanation of Sheets 187, 195, and 196 of the 'Memoirs of the Geological Survey, Ireland,' illustrating part of the county of Cork, is dated 1864, and the section of "Palæontological Notes" is by Mr. Baily. The following Lamellibranchs are mentioned from the Slaty Carboniferous rocks of the district :

<i>Curtonotus</i> , gen. nov., Salter, <i>elegans</i> .	} All figured on p. 28, figs. 6 a—g.
— <i>elegans</i> , var. <i>elongatus</i>	
— — var. <i>rotundatus</i>	
— <i>centralis</i>	
<i>Cucullæa Hardingii</i> .	
— <i>trapezium</i> .	
— <i>angusta</i> .	
— <i>depressa</i> , Phill.	
— <i>amygdalina</i> .	
— <i>Griffithii</i> , Salter, MS.	
<i>Avicula Damnoniensis</i> .	
<i>Modiola Macadamii</i> .	

And a general list of fossils, including the Lamellibranchs, and the localities at which they occur is given at pp. 16 and 17.

The Explanation of Sheets 192 and 199, "Counties of York and Kerry, with Palæontological Notes" by Mr. Baily, was also published the same year. In addition to a general list of fossils and their localities, figures are given of *Cucullæa Griffithii*, *Nucula tenuiarata*, Sandberger, and *Axinus*, sp. *Pterinea spinosa*, Phill, is also mentioned as occurring with the others named above in the Lower Carboniferous slates and grits.

1864. In the 'Transactions of the Geological Society of Glasgow,' vol. ii, 1864–7, pt. 1, p. 28, is a paper by James Armstrong, read December 8th, 1864, entitled "Description of Two New Species of Cypricardia from the Carboniferous Limestone of Lanarkshire," in which *Cypricardia acuticarinata* and *C. crebricostata* are described and figured.

1864. In the 'Memoirs of the Geological Survey of Great Britain,' "Geology of the Country round Oldham," Mr. Salter, in the "Appendix on the Fossils," figures *Aviculopecten papyraceus*, *A. fibrillosus*, sp. nov., and *Ctenodonta*, sp. inc., from a marine bed over the Great Mine in the Middle Coal-measures of Ashton-under-Lyme.

1865. Another paper by Winchell was published in the 'Proceedings of the Academy of Natural Science of Philadelphia' for 1865, entitled "New Species of Fossils from the Marshall group of Michigan," pp. 109, &c.



The following new genera and species are described, but no figures are given :

<i>Ostrea patercula.</i>	<i>Myalina Lowensis.</i>
<i>Pterinea spinalata.</i>	<i>Edmondia ? bicarinata.</i>
<i>Aviculopecten Caroli.</i>	— <i>æquimarginalis.</i>
— <i>tenuicostus.</i>	— <i>Burlingtonensis.</i>
<i>Pernopecten</i> , nov. gen., <i>limæformis.</i>	<i>Sanguinolites strigatus.</i>
— <i>limatus.</i>	— <i>concentricus.</i>
— <i>Shumardanus.</i>	— <i>Hannibalensis</i> , Shumard.
<i>Pinna ? Marshallensis.</i>	<i>Sanguinolaria rostrata.</i>

1865. Several species of Carboniferous Lamellibranchiata are listed in Huxley and Etheridge's 'Catalogue of the Collection of Fossils in the Museum of Practical Geology,' but nothing new is enumerated, and no descriptive details are added.

1865. In the 'Proceedings of the Academy of Natural Science of Philadelphia' for 1865 is a paper by Messrs. Meek and Worthen, entitled "Contributions to the Palæontology of Illinois and other Western States," in which the following Lamellibranchs are described from Carboniferous beds (p. 245) :

<i>Lithophaga ? lingualis.</i>	<i>Edmondia ? peroblonga.</i>
<i>Pleurophorus subcostatus.</i>	<i>Chænomya ? rhomboidea.</i>
— <i>? angulatus.</i>	— <i>? hybrida.</i>
— <i>costatiformis.</i>	<i>Sedgwickia (Sanguinolites ?) subarcuata.</i>
<i>Conocardium obliquum.</i>	

1865. In vol. xiv of the 'Smithsonian Contributions to Knowledge' for 1865 is a memoir entitled "Palæontology of the Upper Missouri: Invertebrates," by Meek and Hayden. A new arrangement of the genera allied to *Avicula* is proposed, pp. 27, 30, and 51, thus :

#### PTERIIDÆ = AVICULIDÆ.

1. *Pteriniinæ*.—"Cartilage apparently occupying a series of linear furrows, ranging more or less nearly parallel to the cardinal margin in a usually broad, flattened cardinal facet or area. Anterior muscular scar sometimes moderately developed and deep."

*Pterinia*, *Myalina*, *Ambonychia*, and probably *Actinodesma*, *Gryphorhynchus*, *Eurydesma*, and several undefined Palæozoic groups.

2. *Pteriinæ* (or *Aviculinæ*).—"Cartilage mainly or entirely confined to a single more or less defined depression or cavity behind the beaks. Anterior muscular impression very small."

*Pteroperna*, *Pteria* (or *Avicula*), *Margaritifera*, *Malleus*, *Aucella*, and *Eumicrotis*; also probably *Monotis*, *Halobia*, *Pteronites*, and *Posidonomya*.

3. *Melvininæ*.—"Cartilage divided and distributed along the hinge in a series of furrows crossing the cardinal area at right angles to the hinge-line. Anterior muscular scar generally very small."

*Crenatula*, *Melina* (= *Perna*, Brug. not Adanson) *Bakevellia*, *Gervillia*, *Inoceramus*, and *Pulvinites*.

The affinities of *Myalina* are discussed, and its close resemblance with *Dreissena* noted; two forms, *M. perattenuata*, M. and H., and *M. subquadrata*, Shumard, are figured and described.

The Family *Crassitellidæ* is made to include a large number of dissimilar genera. The Carboniferous genera, *Pachydomus*, *Carbonicola*, *Pleurophorus*, are placed with *Astarte*, *Crassitella*, *Cardinia*, and many others.

*Pleurophorus* is stated to be identical with *Cleidophorus*, Hall, and *Pleurophorus occidentalis*, Meek and Hayden, is redescribed and figured from the Coal-measures of Nebraska.

Under the family *Anatinidæ*, with *Thracia*, *Pandora*, *Pholadomya*, and other recent genera, are grouped *Cercomya*, *Anthracomya*, *Allorisma*, *Myacites*, *Chænomya*, *Arcomya*, *Mactromya*, *Goniomya*, *Gresslya*, *Cardiomorpha*, *Ceromya*, *Sedgwickia*, *Sanguinolites*, and probably *Cleobis*, and some species of *Orthonota*; a classification which cannot be retained for one moment, on anatomical and structural reasons. *Allorisma subcuneata*, Meek and Hayden, is redescribed and figured. The genus *Sedgwickia* is defined and discussed. *S.?* *Topekaensis*, Shumard, and *S.?* *concava*, Meek and Hayden, are described and figured. The new genus *Chænomya*, Meek, is defined; and *Chænomya?* *Leavensworthensis*, M. and H., equals *Allorisma?* *Leavensworthensis*, M. and H.; and *C. Cooperi*, M. and H., equals *Panopæa Cooperi* and *Allorisma?* *Cooperi*, M. and H.

1866. Geinitz's work on the 'Carbon-Formation und Dyas in Nebraska,' was published in 1866. The following Lamellibranchs are described, and some of them figured, from Carboniferous strata:

*Allorisma subcuneata*, Meek and Hayden.

— *Leavensworthensis*, Meek and Hayden.

*Solemya biarmica*, de Vern.

*Astarte gibbosa*, M'Coy.

*Pecten grandævus?* Goldfuss.

— *Missouriensis?* Shumard.

In 1866 a further paper by Meek and Worthen appeared in vol. i of the 'Proceedings of the Chicago Academy of Nat. Sciences,' p. 11, called "Descriptions of Palæozoic Fossils from the Silurian, Devonian, and Carboniferous Rocks of Illinois and other Western States," pp. 13—20.

The following new species are described from Carboniferous beds:

*Placunopsis carbonaria.*  
*Aviculopecten Randolphensis.*  
 — *Indianensis.*  
*Aviculopecten fimbriatus.*  
*Macrodon*\* *tenuistriatus.*

*Schizodus curtus.*  
*Anthracoptera fragilis.*  
*Myalina meliniformis.*  
*Pterinea (Monopteria) gibbosa.*

*Monopteria* is proposed as a new sub-genus of *Pterinea*.

1866. In the same year the same authors, in vol. ii (Palæontology) of the 'Geological Survey of Illinois,' figured and redescribed—

*Aviculopecten Coxanus.*  
 — *Oweni.*  
 — *amplus.*  
 — *oblongus.*  
 — *pellucidus.*  
 — *Burlingtonensis.*  
 — *Koninckii.*  
 — *interlineatus.*  
 — *occidentalis*, Shumard?  
*Streptopteria?* *tenuilineata.*  
*Eumicrotis*, *Hawni*, var. *sinuata.*  
*Pterinea*, sub-genus *Monopteria*, M. and W.  
 — (*Monopteria*) *gibbosa.*

*Myalina Swallowi*, M<sup>c</sup>Chesney.  
 — *meliniformis.*  
 — *recurvirostris.*  
 — *concentrica.*  
 — *angulata.*  
*Schizodus*, sp.?  
 — *Chesterensis.*  
*Edmondia unioniformis*, Phillips?  
*Nuculana?* *curta.*  
*Pleurophorus subcostatus.*  
*Solenomya radiata.*  
*Cardiopsis radiata.*  
*Allorisma*, sp.

These species had all been described before by the same authors or others, but with few exceptions no figures had previously been given.

1866. In 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1866, pp. 259—261, Messrs. Meek and Worthen describe *Pteria* (*Pterinea*?) *Morganensis* from the Coal-measures, and *Macrodon micronema* from the Chester group (Sub-carboniferous) of Illinois.

1867. The 'American Journal of Science and Art,' 2nd ser., vol. xlv, contains at pp. 170 and 327 a long critical review, by Meek, of Geinitz's, 'Upper Palæozoic Rocks and Fossils of South-eastern Nebraska.' Nearly all the specific names of the fossil shells are challenged, and many of the genera.

1868. In vol. iii of the 'Geological Survey of Illinois,' "Geology and Palæontology," Messrs. Meek and Worthen describe and figure—

*Pernopecten Shumardianus*, Winchell?  
*Pterinea?* *undulata*, M. and W.\*  
*Aviculopecten Indianensis*, M. and W.  
*Anthracoptera?* *fragilis*, M. and W.  
*Pleurophorus costatiformis*, M. and W.  
*Sedgwickia* (*Sanguinolites*?) *subarcuata*, M. and W.  
*Lithophaga lingualis*, Phillips?  
*Allorisma* (*Chænomys*?) *hybrida*, M. and W.

} From the Kinderhook group of Burlington,  
 Iowa, pp. 453—456.

} From the Keokuk group of the Lower  
 Carboniferous series, pp. 532—539.

\* The name *Parallelodon* is proposed as a substitute for *Macrodon*, because the latter had been in use since 1862 for a genus of fishes



These species had all been described before, with the exception of the one marked by an asterisk (\*), but no figures had previously been given.

1868-78. Sir William Dawson described as new the following Marine Lamellibranchiata, from the Carboniferous beds of Nova Scotia, in his 'Acadian Geology,' all except five are also figured :

*Modiola Pooli.*  
— *Avonia.*  
*Pteronites Gayensis.*  
*Bakewellia antiqua.*  
*Macrodon Hardingi.*  
— *curtus.*  
— ? *Shubenacadiensis.*  
*Edmondia Harttii.*  
— *anomala.*  
*Cypricardia insecta.*  
*Pleurophorus quadricostatus.*

*Cardinia subangulata.*  
— *Antigonensis.*  
*Arca punctifer.*  
*Cardiomorpha Vindobonensis, Hartt.*  
*Conocardium Acadianum.*  
*Aviculopecten Lyelli.*  
— *reticulatus.*  
— *simplex.*  
— *Acadicus.*  
— *Cora.*  
— *Debertianus.*

1869. In the 'Proceedings of the Academy of Natural Science of Philadelphia' for 1869 is a paper, "Description of New Carboniferous Fossils from the Western States," by Meek and Worthen, pp. 70, 71. In this contribution only two Carboniferous Lamellibranchs are described, both new, one belonging to a new genus, *Chænocardia*, *C. ovata* and *Allorisma costata*. The diagnosis of the genus *Chænocardia* is given, and at p. 72 the generic name *Prothyris* is proposed for a shell.

1869-87. The first edition of the 'Geological Survey Memoir' on the Limestone District of Derbyshire was published in 1869. It contains a list of fossils gathered from various localities; pp. 174-179 of the 2nd edit., 1887.

1870. Messrs. Meek and Worthen presented a paper in April, 1870, to the Academy of Natural Sciences of Philadelphia, published in the volume of 'Proceedings' for that year, pp. 22, &c., entitled "Descriptions of New Species and Genera of Fossils from the Palæozoic Rocks of the Western States." Two new genera of Lamellibranchs, *Carbonarca* and *Clinopistha*, are described, and the following species enumerated from Carboniferous strata (no figures are given) :

*Monotis? gregaria.*  
*Aviculopecten spinuliferus.*  
*Carbonarca gibbosa.*

*Macrodon delicatus* (*Parallelodon* in a foot-note at p. 40).  
*Schizodus amplus.*  
*Clinopistha radiata*, var. *lævis.*

1871. In the 'Transactions of the Geological Society of Glasgow,' vol. iii, is a paper by Mr. R. Craig (read January 9th, 1869) on "The Carboniferous Basin of Dalry," with lists and localities of fossils.

1871. Two papers by Meek occur in the 'Proceedings of the Academy of



Natural Sciences of Philadelphia' for 1871. In the former, entitled "Description of New Species of Invertebrate Fossils from the Carboniferous and Devonian Rocks of Ohio," pp. 57, &c., the diagnosis of the following Lamellibranchs from the Waverley group of the Carboniferous series is given :

<i>Aviculopecten crenistriatus.</i>		<i>Allorisma (Sedgwickia?) pleuropistha.</i>
— ( <i>Streblopteria?</i> ) <i>Hertzeri.</i>		<i>Grammysia? rhomboides.</i>
<i>Sanguinolites? obliquus.</i>		— <i>ventricosa.</i>

The second paper is entitled "Description of New Species of Fossils from Ohio and other Western States and Territories," pp. 159, &c., and contains descriptions of—

<i>Pterinea (Pteronites?) Newarkensis,</i>		<i>Schizodus subtrigonalis,</i>
<i>Cypricardina? carbonaria,</i>		<i>Allorisma Winchelli,</i>
<i>Schizodus Medinaensis,</i>		— <i>ventricosum,</i>

—all from the Waverley group of strata.

1871. On May 24th, 1871, J. Logan Lobley read a paper on the "Principal Features of the Stratigraphical Distribution of the British Fossil Lamellibranchiata," in which he gives tables and diagrams indicating the number of species of each family of Carboniferous Lamellibranchiata then known from British strata; 'Quart. Journ. Geol. Soc.,' vol. xxvii, pp. 411—418. He enumerates eighteen genera with 403 species. In Tables ii and iii he gives 398 species, 282 of which belong to the Asiphonidæ, and 116 to the Siphonidæ.

1871-6. In 1871 Messrs. Young and Armstrong prepared an elaborate catalogue of the Carboniferous Fossils of the West of Scotland, which was published in 1871 as an appendix to vol. iii of the 'Transactions of the Geological Society of Glasgow.' This was published as a separate volume in 1876, on the occasion of the visit of the British Association to Glasgow. One hundred and twenty-five species are enumerated, belonging to twenty-nine genera, and a long and full list of the localities where each species is found is also given. Nothing new is described.

1871. Vol. iii of the 'Palæontologia Indica' (Memoirs of the Geological Survey of India), "The Cretaceous Fauna of Southern India' by F. Stoliczka, published in 1871, contains a synoptical list of the families and genera noticed in the volume. In it the Carboniferous genera of Lamellibranchs (Pelecypoda) published up to that date are entered with the type-species, recent and fossil. They are grouped in ten orders and forty-six families. Critical notes are also given. Further researches have, however, in certain cases shown the error of some of these references.

1872. Meek's "Report on the Palæontology of Eastern Nebraska" forms a part

of the 'Final Report of the United States Geological Survey of Nebraska,' which is dated 1872.

Many Carboniferous Lamellibranchs are described and figured, with the following new forms, pp. 195, 212—220 :

*Aviculopecten Whitei.*

*Pleurophorus oblongus.*

*Edmondia reflexa.*

— ? *glabra.*

*Edmondia subtruncata.*

— *Aspinwallensis.*

*Allorisma (Sedgwickia) reflexa.*

— (—) *subelegans.*

In many cases the generic names of the original authors are revised.

1872. Mr. W. H. Baily read a paper before the Royal Geological Society of Ireland on April 12th, 1872, subsequently published in vol. xiii (vol. iii, new series) of the Journal of that Society, entitled "Remarks on the genus *Pleuro-rhynchus*, with a description of a new species. He shows that the genus ranges from the Caradoc-beds to the Carboniferous Limestone, eight species being from the latter formation. He gives figures and descriptions, p. 25, pl. iv, figs. 1 *a—d*, of *Pleuro-rhynchus Koninckii*, which occurred in the Lower Limestone near Rathkeale, co. Limerick, and states that the name was recorded at the Meeting of the British Association in Dublin as early as 1865.

The contribution of Mr. R. Etheridge, jun., to the Palæontology of the Carboniferous series are many and valuable, and extend over a series of years, commencing in 1872 to 1882. It will be convenient to mention all these papers in series, giving the date of each.

His first communication occurs in the 'Explanation of Sheet 22 of the Map of the Geological Survey of Scotland,' published in 1872, the preface dating 1871. It consists of a stratigraphical list and table of the fossils found in the district comprised, with the map showing the horizons at which the several fossils occur, and the vertical range of each. There is a short note on *Aviculopecten Sowerbii*, M'Coy, on p. 50, under Section iv, "Description of Species."

1873. In the Explanation of Sheet 23 of Scotland are three appendices by Mr. R. Etheridge, jun.: No. 1, a list of localities; No. 2, a list of fossils arranged stratigraphically; No. 3, notes on certain genera and species mentioned in the foregoing lists, in which the following species of Carboniferous Lamellibranchiata are described; but no figures are given :

*Aviculopecten ornatus.*

„ sp. (afterwards named *A. oryza*,  
'Geol. Mag.,' p. 303, 1874.

*Posidonomya corrugata.*

*Pteronites fluctuosus.*

*Anthracosia*; its burrowing habits and  
affinities,

*Leda intermedia.*

1873. In the 'Geological Magazine,' vol. x, pp. 297—299, a paper "On some

undescribed species of Lamellibranchiata from the Carboniferous Series of Scotland" was published, when the following new species were described pp. 297, 298 :

*Conocardium decussatum.*  
*Pteronites regularis.*

*Myacites ? (Allorisma) tenuilineata.*

Later in 1873, and in the same volume, p. 344, is another of his "Contributions to Carboniferous Palæontology," "On some further undescribed species of Lamellibranchiata from the Carboniferous Series of Scotland," in which is a review of the genus *Pteronites*, M'Coy.

The new species, mentioned in his Appendix to the Memoirs Geol. Survey Scotland, Explanation of Sheet 23, are here described and figured (pl. xii, figs. 5—7) :

*Pteronites fluctuosus.*  
*Aviculopecten ornatus.*

*Leda intermedia.*

On the same plate xii, which was not published till September, figures are given of the species described in July (*vide supra*).

1873. In the fifth vol. of the 'Geological Survey of Illinois,' dated 1873, Messrs. Meek and Worthen describe and figure the following new Lamellibranchs from the Lower Carboniferous, St. Louis group (pl. xxii) :

*Lithophaga ? pertenuis,*  
*Myalina Sancti-Ludovici,*  
*Chænomya ? rhomboidea,*

*Allorisma sinuata ?* (without any notice  
in the letterpress of the last) ;

and the following new forms (pp. 573—586) from the Coal-measures (pls. xxvi and xxvii) :

*Monotis ? gregaria.*  
*Macrodon delicatus.*  
— *tenuistriatus.*  
*Avicula Morganensis.*  
*Placunopsis carbonaria.*  
*Schizodus amplus.*  
— *perelegans.*

*Schizodus curtus.*  
*Olinopistha radiata*, var. *lævis.*  
*Edmondia ? peroblonga.*  
*Allorisma costata.*  
— *Geinitzi.*  
*Chænocardium ovatum.*

Figures of ten other previously described bivalve shells are also given.

1874. A paper entitled "The Fossils of the Carboniferous Strata of the West of Scotland," by J. Young and James Armstrong, read March 13th, 1873, published in vol. iv, p. 267, of the 'Transactions of the Geological Society of Glasgow' gives a list of the fossils found in the district of Robroyston.

1874. In dec. 2, vol. i, p. 300, of the 'Geological Magazine,' is a paper entitled "Notes on Carboniferous Lamellibranchiata (*Monomyaria*)," by R. Etheridge, jun.



In this paper a full list of synonyms with description and figures are given of *Pecten Sowerbii*, M'Coy, and *Aviculopecten ellipticus*, Phillips. The *Aviculopecten*, sp., of the Explanation of Sheet 23 (p. 103) is now named *A. oryza*, without a figure; but *Posidonomya corrugata*, of the same memoir, is now redescribed and figured.

1875. In the 'Report of the Explorations and Surveys West of the 100th Meridian,' vol. iv, pt. 1, issued in 1875, C. A. White describes (p. 146, &c.) from Permo-Carboniferous beds—

<i>Aviculopecten occidentalis.</i>	<i>Myalina</i> , sp.?
— <i>Coreyanus.</i>	— ? <i>Swalleri.</i>
— <i>MacCoyi.</i>	<i>Bakevellia parva.</i>
— ? <i>interlineatus.</i>	<i>Schizodus Wheeleri.</i>
<i>Pinna peracuta</i> ?	<i>Allorisma subcuneata</i> , var.
<i>Monopteria Marian.</i>	

In the same year, in "Carrol, Montana, to Yellowstone National Park, Ludlow," p. 143,<sup>1</sup> R. P. Whitfield described *Pinna Ludlovi* from Carboniferous beds.

1875. In the 'Report of the Geological Survey of Ohio,' F. B. Meek describes and figures in vol. ii, part 2, Palæontology, several Lamellibranchs from the Waverley Sub-Carboniferous series, pp. 292—312, amongst which are the following new forms :

<i>Aviculopecten Winchelli.</i>	<i>Edmondia? tapesiformis.</i>
<i>Palæoneilo Bedfordensis.</i>	<i>Promacrus Andrews.</i>

The nine species described in the 'Proceedings of the Academy of Natural Science of Philadelphia' for 1871 (pp. 159—168) are here figured for the first time.

The following Lamellibranchs (all new except two) are described and figured from the Coal-measures (pp. 330—344) :

<i>Aviculopecten (Streblopteria?) Hertzeri.</i>	
<i>Placunopsis recticardinalis.</i>	
<i>Posidonomya fracta.</i>	
<i>Macrodon obsoletus,</i>	} mentioned in the List of Carb. Foss. from West Virginia. (Report, Regent's Univer- sity of West Virginia.)
<i>Yoldia Stevensoni,</i>	
<i>Yoldia (Palæoneilo) carbonaria,</i>	
<i>Schizodus cuneatus.</i>	
<i>Aviculopinna Americana</i> (Pal. East Nebraska).	
<i>Pleurophorus tropidophorus.</i>	
<i>Solenomya? anodontoides.</i>	
<i>Astartella Newberryi.</i>	
— sp.	
— <i>varica</i> (McChesney).	
<i>Cypricardinia? carbonaria.</i>	
<i>Allorisma costata</i> , Meek and Worthen.	

<sup>1</sup> As quoted by C. D. Walcott, 'Pal. Eureka,' &c., p. 225.



1875. Two other papers by R. Etheridge, jun. appeared in 1875; one in the 'Geological Magazine' for June, 1875, dec. 2, vol. ii, p. 241, "On some Undescribed Carboniferous Fossils," in which is described and figured a new species, *Modiola lithodomoides*. The other paper appeared in No. 53 of ser. iv, vol. xv, p. 427, of the 'Annals and Magazine of Natural History,' and was entitled "Notes on Carboniferous Lamellibranchs." A long description and observations with five figures (pl. xx) are given of *Myalina crassa* (Fleming), and *Schizodus Salteri*, with four figures, is described as new; this shell from Fifeshire, was noticed in 1861 by the Rev. T. Brown and J. W. Salter, 'Trans. Roy. Soc. Edin.,' vol. xxii, p. 392.

1875. Vol. i, the only one ever issued, of Baily's "Figures of Characteristic Fossils, with descriptive remarks," 1867-75, contains figures of—

- Avicula Damnoniensis*, Sow., } from the Upper Devonian of Pilton and Lower  
*Cucullæa Hardingii*, Sow., } Carboniferous, of Coomhola, co. Cork.  
*Anodonta Jukesii*, Forbes, Kiltorecan beds.  
*Aviculopecten papyraceus*, Goldfuss, sp.  
 — *granosus*, Sow., sp.  
 — *Sowerbii*, M'Coy, sp.  
*Posidonomya Becheri*, Bronn.  
 — *membranacea*, M'Coy.  
*Modiola Macadamii*, Portl.  
*Pleurorhynchus Hibernicus*, Sow., sp.  
*Anthracosia centralis*, Sow., sp.  
 ? *Myacites Omaliana*, De Kon., sp.  
*Cardiomorpha oblonga*, Sow., sp.  
*Curtonotus elegans*, Salter, Upper Dev. Pilton Group, and Coomhola grit, co. Cork.

A list of local Carboniferous Lamellibranchs is given in "Geological Notes on the Cuttings in the City of Glasgow Railway between Bellgrove and Springburn," by James Neilson, published in the volume of the 'Transactions of the Geological Society of Glasgow' for 1875, vol. v, p. 222.

1875. Vol. vi of the 'Geological Survey of Illinois' was published in 1875, and contains figures and descriptions, by A. H. Worthen and F. B. Meek, of—

- Pinna subspatulata*, W., pl. xxx, fig. 4, p. 524.  
*Myalina Keokuk*, W., pl. xxx, fig. 5, p. 524.  
*Conocardium obliquum*, M. and W., pl. xxxiii, fig. 4, p. 529.  
*Pleurophorus ? angulatus*, M. and W., pl. xxxiii, fig. 5, p. 529.  
*Carbonarca gibbosa*, M. and W., pl. xxxiii, fig. 6, p. 531.

The last three had been described in preliminary notices in the 'Proc. Acad. Nat. Sci. Philadelphia' for 1865, p. 247, &c., and 1870, p. 40.

1876-86. A valuable series of papers by Mr. G. H. Morton appeared in vol. iii, pp. 156, 299, and 371 of the 'Proceedings of the Liverpool Geological Society,' on "The Carboniferous Limestone and Millstone-grit of North Wales." No new forms of Carboniferous Lamellibranchiata are described, but the zonal distribution of the fossils is most carefully recorded. A further paper on the Carboniferous Limestone and Cefn-y-Fedw Sandstone of Flintshire is contained in vol. iv, pp. 297, 381 (1883), and v, p. 169, (1886), of the same 'Proceedings,' careful lists of fossils being given for each bed described.

1876. In the April number of the 'Geological Magazine,' dec. 2, vol. iii, p. 150, R. Etheridge, jun., gave in his "Notes on Carboniferous Mollusca," full accounts and figures (pl. vi) of *Aviculopecten papyraceus*, Sowerby, sp., *Aviculopecten ? sublobatus*, Phillips, and some remarks on *Aviculopecten planoradiatus*, M'Coy.

1876. Another paper by him, "Notes on Carboniferous Lamellibranchiata," was published in the August number of the 'Annals and Magazine of Natural History,' series 4, vol. xviii, p. 96, &c. The following species are described, those marked with an asterisk being new, and figures are given (pl. iv) of those species marked with a dagger :

*Aviculopecten subconoides*.\* †  
 — *cælatus*, M'Coy ?  
*Edmondia unioniformis*, Phillips. †  
*Leda Traquairii*.\* †

*Leptodomus fragilis*, M'Coy. †  
 — ? *clavatus*.\* †  
*Myalina ? trigonalis*.\* †  
*Nucula Youngi*.\* †

1877. In the 'Report of the United States Geological Explorations of the 40th Parallel,' issued in 1877, vol. iv, part 1, Meek describes and figures *Aviculopecten Utahensis* and *A. occidentalis* from Carboniferous strata. In part 2, Messrs. Hall and Whitfield also describe and figure as new *Aviculopecten Weberensis*, *A. curtocardinalis*, and *A. parvulus*, from Permo-Carboniferous beds.

1877. In the June number of the 'Geological Magazine,' dec. 2, vol. iv, p. 241, R. Etheridge, jun., gave "Further Contributions to British Carboniferous Palæontology."

*Aviculopecten Sowerbii* and *A. ellipticus* are now stated to be the right and left valves of one species, figures being given in proof of this view (pl. xii). A new figure of *A. papyraceus* is also given to show a variety of surface ornamentation. *Anthracomya Phillipsii* is fully described and figured, and two new species, *Anthracomya Scotica* and *Sanguinolites ? Abdenensis*, are figured and described for the first time.

1878. In the volume of the 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1878, p. 35, C. A. White describes as new *Astartella Gurleyi* from Carboniferous beds of Illinois, in a paper entitled "Descriptions of New Species of Invertebrate Fossils from the Carboniferous and Upper Silurian Rocks of Illinois and Indiana."

1878. On November 7th, 1877, a paper by R. Etheridge, jun., was read before the Geological Society, published in No. 133, vol. xxxiv, p. 1, 1878. "On our Present Knowledge of the Invertebrate Fauna of the Lower Carboniferous or Calciferous Sandstone Series of the Edinburgh Neighbourhood, especially of that division known as the Wardie Shales, and on the First Appearance of certain Species in these Beds."

The following species of Lamellibranchs are figured and described for the first time (Pls. i and ii) :

*Avicula Hendersoni.*  
*Anthracoptera? obesa.*  
*Myalina sublamellosa.*

*Nuculana Sharmani.*  
*Pandora? typica.*

Figures are also given of *Schizodus Salteri* and *Anthracosia? nucleus*, and notes are added on *Myalina crassa*, var. *modioliformis*, Brown, and *Anthracomya Scotica*, Etheridge.

1878. In the July number of the 'Annals and Magazine of Natural History,' series 5, vol. ii, p. 30, is a short paper by R. Etheridge, jun., entitled "Notes on Carboniferous Mollusca," which consists of two short articles:—No. 1, "On the Hinge-structure and Generic Affinity of *Pecten Sowerbii*, M'Coy;" No. 2, "On the Hinge-structure of *Nucula gibbosa* (Fleming) and *Nuculana attenuata* (Fleming)," with a plate (pl. i) in illustration of both subjects.

1878. In his 'Thesaurus Devonico-Carboniferus' Dr. Bigsby gave a list of all the species and genera described from European, North-American, and Australian Carboniferous beds, with a list of authors and publications.

1878. The 'Manual of the Geology of Ireland,' by G. H. Kinahan, contains two plates, iii and iv (pp. 63 and 95), of Carboniferous fossils, among which the following Lamellibranchs are figured, no descriptions, however, being given:

*Aviculopecten Sowerbyi.*  
*Pleurorhynchus Koninckii.*  
*Modiola Macadamii.*  
*Aviculopecten papyraceus.*  
*Posidonomya Becheri.*

*Posidonomya membranacea.*  
*Myacites fabæformis.*  
*Anthracosia Bilboensis.*  
*Lunulocardium Footii.*

1879. In the 'Neues Jahrbuch für Mineralogie,' &c., for 1879, von Koenen describes, in his paper on "Die Kulm Fauna von Herborn," the following new Lamellibranchs, pp. 327, &c. :

*Pecten Losseni.*  
 — *prætenuis.*  
 — *perovalis.*  
*Avicula? latisulcata.*

*Avicula Kochi.*  
*Myalina mytiloides.*  
*Arca Rittershauseni.*  
 — *Decheni.*

All are figured (pl. vi) with the exception of the last.



1879. In the 'Bulletin of the United States Geological Survey of the Territories,' vol. v, No. 2, 1879, C. A. White, in his "Remarks on certain Carboniferous Fossils from Colorado, Arizona, &c.," pp. 216, 217, describes as new—

*Nuculana obesa.*

*Nucula perumbonata.*

*Allorisma? Gilberti.*

(All from Northern Arizona.)

In 1879 the Explanation of Sheet 31 of 'Memoirs of the Geological Survey of Scotland' was published, with an Appendix by Mr. R. Etheridge, jun., on the localities of the fossils found in the area contained in the map. At p. 80 are "Notes on some of the Species," three new species of Carboniferous Lamelli-branchiata being described:

*Aviculopecten*, sp. ind.

— *subanisotus.*

*Anthracoptera tumida.*

1881. Mr. Robert Etheridge, sen., gave his presidential address to the Geological Society "On the Analysis and Distribution of the British Palæozoic Fossils" in 1881, subsequently published in No. 146, vol. xxxvii, of the 'Quarterly Journal.' At page ccxvi he states that the Monomyaria "and the Dimyaria united number no less than 54 genera and 415\* species." Ten genera, with 179 species, belong to the Monomyaria, 103 of which are referred to *Aviculopecten*; and 43 genera, with 245 species, are included in the Dimyaria.

Tables are given showing the number of species in several genera of Mono- and Dimyarians which occur in England, Scotland, Ireland, Belgium, and America, and the number of genera and species occurring in certain subdivisions of the Carboniferous beds are also indicated.

1882. On the 13th January, 1880, Mr. John Young read his "Notes on some Carboniferous Lamellibranchs, their Mode of Occurrence and observed Shell-structure," which were published in vol. vi of the 'Transactions of the Geological Society of Glasgow,' p. 223. He records the following genera as possessing a prismatic cellular structure in the shell: *Anthracoptera*, *Pinna*, *Pteronites*, *Posidonomya*, and *Myalina*. He says, "So far as I have examined my Carboniferous Lamellibranchs, I find that this prismatic cellular structure is confined to shells belonging to the *Aviculidæ*, or wing-shells, and the *Mytilidæ*, or

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\* On the next page this figure is more correctly given as 424, 179 + 245.



mussels, thus agreeing with what is known of the shell-structure of the recent species in these families."

1882. Mr. R. Etheridge, jun., gave the opening address before the Royal Physical Society of Edinburgh on November 16th, 1881, entitled "The Palæozoic Conchology of Scotland." In it he summarised the knowledge then attained of the Carboniferous Lamellibranchiata of Scotland, with very valuable but brief remarks on each family and genus, and their systematic position in the general classification of the group, with a short discussion on the value of each division.

1882. On June 23rd, 1880, Mr. Kirkby read a paper before the Geological Society, published in No. 144, vol. xxxvi, p. 559, of the 'Quarterly Journal,' "On the Zones of Marine Fossils in the Calciferous Sandstone Series of Fife." At the end of this paper (p. 583) are "Notes on the Species," in which the following forms are discussed, but no figures are given :

*Avicula recta*, M'Coy  
*Cypricardia bicosta*, sp. nov.,  
*Myalina modioliformis*, Brown,  
*Sanguinolites Abdenensis*, Etheridge,

*Sanguinolites subplicatus*, sp. nov.,  
*Sedgwickia gigantea*, M'Coy,  
*Pleurophorus elegans*, sp. nov.,

with a table showing the vertical range of each of these, with other fossils.

1882. The "Recherches sur les Terrains anciens des Asturies et de la Galice," by Dr. C. Barrois appeared in 1882 ('Mém. Soc. Géol. du Nord,' tome ii, No. 1), the following species of Carboniferous Lamellibranchs being described and figured :

*Lima Buitrago*, sp. nov.  
*Aviculopecten cf. scalaris*, Sow.  
*Pecten dissimilis*, Flem.  
*Carbonarca Cortazari*, sp. nov.  
*Macrodon Monreali*, sp. nov.  
*Otenodonta Halli*, sp. nov.  
*Schizodus curtus*, Meek.  
— *Rubio*, sp. nov.  
— *sulcatus*, Sow.  
*Edmondia Calderoni*, sp. nov.

*Sanguinolites cf. subcarinata*, M'Coy.  
*Cardiomorpha sulcata*, Koninck.  
*Astarte subovalis*, Mallada.  
— *MacPhersoni*, sp. nov.  
*Anthracosia bipennis*, Brown.  
— *carbonaria*, Schloth. and de Koninck.  
*Myalina triangularis*, Sow.  
— *carinata*, Sow.  
*Naiadites Tarini*, sp. nov.

1882. Dr. Hunter gives lists of Carboniferous Lamellibranchiata from the various beds included in his paper on "The Geology and Palæontology of Bankend, Bellfield, and Coalburn, Lesmahagow," published in the 'Transactions of the Geological Society of Glasgow,' vol. vii, for 1882, p. 143.

1882. R. P. Whitfield read a paper on January 16th, 1882, published in the

'Annals of the New York Academy of Science,' vol. ii, No. 7, March, 1882, entitled "Descriptions of New Species of Fossils from Ohio," &c., in which three new forms (pp. 221, 222) are described (to be figured in Palæont., Ohio, vol. iii):

*Pinna Maxvillensis.*  
*Allorisma Andrews.*

*Allorisma Maxvillensis.*

1883. Vol. vii of the 'Geological Survey of Illinois' appeared in 1883. It contains woodcuts (pp. 318 and 321) of two and descriptions (p. 326) of other Lamellibranchs from Carboniferous beds by Worthen:

*Chænomys Maria.*  
*Aviculopecten Varsoviensis.*

*Pinna Sancti Ludovici,*  
*Cypricardia? Randolphensis,* } descriptions  
only.

1884. Vol. viii of the 'Monographs of the United States Geological Survey,' issued in 1884, is entitled 'Palæontology of the Eureka District,' by C. D. Walcott. Out of forty-four species of Lamellibranchiata from Carboniferous strata (pp. 225—254), thirty-seven are described as new. It is stated (p. 226) that "the relations of the greater number of the species are with Devonian and Lower Carboniferous species rather than with those of the Coal-measure Groups of the Mississippi Valley."

*Aviculopecten Haugei.*  
— *Eurekensis.*  
— *peroccidens.*  
— *Pintoensis.*  
— *affinis.*  
— *sp.?*

*Streblopteria similis.*  
*Crenipecten Hallanus.*  
*Perinopecten Hoosacensis.*  
— *Spio.*

*Pterinea Pintoensis.*  
*Leptodesma, sp.?*  
*Ptychopteria protoformis.*  
*Pinna inexpectans.*

— *consimilis.*  
*Myalina congeneris.*  
— *Nemensis.*  
— *Nessus.*

*Modiola? Nevadensis.*  
*Modiomorpha ambigua.*

*Modiomorpha? desiderata.*

— *? Pintoensis.*

*Nucula insularis.*

— *levatiformis.*

*Solenomya curta.*

*Macrodon Hamiltonæ, Hall.*

*Macrodon truncatus.*

*Grammysia Hannibalensis, Shumard, sp.*

— *arcuata, Conrad, sp.*

*Edmondia Medon.*

— *? circularis.*

*Pleurophorus Meeki.*

*Sanguinolites Æolus (H. and W.).*

— *retusus.*

— *simplex.*

— *Salteri.*

— *? Nænia.*

— *striatus.*

*Microdon (Cypricardia) connatus*

*Cardiola? filicostata.*

*Schizodus cuneatus*, Meek.  
— *deparcus*.

*Schizodus curtiformis*.  
— *Pintoensis*.

1884. In the 'Fourth Annual Report of the U.S. Geological Survey' for 1882-3, issued in 1884, *Ostrea patercula*, Winchell, from the Kinderhook beds of Burlington, Iowa, is figured (pl. xxxiv, figs. 1 and 2, p. 288) in a "Review of the Fossil Ostreidæ of North America" by C. A. White.

1885. The fifth part, tome xi, of the 'Annales du Musée Royal d'Histoire Naturelle de Belgique,' "Faune du Calcaire Carbonifère de la Belgique: Lamellibranches," by L. G. de Koninck, was published in 1885, in the writing of which he associated himself with Dr. Julien Fraipont, many of the species being described by the latter; in such cases the initials J. F. are appended. 461 species of Carboniferous Lamellibranchs are described and figured from Belgian strata, and of these only 35 are recognised as occurring in England, 35 in Ireland, 18 in Scotland, 6 in Germany, 10 in Russia, 6 in America, 1 in France, and 1 in Australia; or in all only 77 species previously described are recognised as occurring in Belgian strata—a very significant and curious result. The list of 461 species are divided into genera which are classed as follows:

## ANATINIDÆ—

1. <i>Chænomya</i> , Meek	.	.	5 species, 2 being new.
2. <i>Cardiomorpha</i> , de Koninck	.	.	18 " 16 "
3. <i>Isoculia</i> , M'Coy	.	.	2 " 1 "
4. <i>Broeckia</i> (new genus), de Koninck	.	.	10 " 9 "
5. <i>Pachydomus</i> , Morris	.	.	8 " 6 "
6. <i>Edmondia</i> , de Koninck	.	.	68 " 54 "
7. <i>Scaldia</i> , de Ryckholt	.	.	10 " 5 "
8. <i>Sanguinolites</i> , M'Coy	.	.	53 " 28 "
9. <i>Promacrus</i> , J. B. Meek	.	.	2 " 0 "

## SOLENIDÆ—

<i>Solenopsis</i> , M'Coy	.	.	2 " 0 "
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## TELLINIDÆ—

<i>Tellinomorpha</i> (new genus), de Koninck	1	"	1 "
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## CYPRINIDÆ—

<i>Cypricardella</i> , Hall	.	.	15 " 7 "
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## TRIDACNIDÆ—

<i>Conocardium</i> , Bronn	.	.	26 " 13 "
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## SOLEMYIDÆ—

1. <i>Solemya</i> , Lamarck	.	.	4 " 1 "
2. <i>Clinopistha</i> , Meek and Worthen	.	.	3 " 2 "

## TRIGONIIDÆ—

<i>Protoschizodus</i> (new genus), de Koninck	14	"	11 "
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## NUCULIDÆ—

1. <i>Nucula</i> , <i>Lamarck</i>	.	.	6 species, 4 being new.
2. <i>Nuculana</i> , <i>Link</i>	.	.	2 „ 1 „

## PECTUNCULINÆ—

<i>Tellinomya</i> , <i>Hall</i>	.	.	2 „ 1 „
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## ARCIDÆ—

<i>Parallelodon</i> , <i>Meek and Worthen</i>	.	.	43 „ 29 „
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## PINNIDÆ—

1. <i>Pinna</i> , <i>Lister</i>	.	.	1 „ 0 „
2. <i>Aviculopinna</i> , <i>Meek</i>	.	.	3 „ 1 „

## MYTILIDÆ—

1. <i>Myalina</i> , <i>de Koninck</i>	.	.	9 „ 5 „
2. <i>Modiola</i> , <i>Lamarck</i>	.	.	19 „ 13 „

## AVICULIDÆ—

1. <i>Posidonomya</i> , <i>Bronn</i>	.	.	5 „ 4 „
2. <i>Posidoniella</i> (new genus), <i>de Koninck</i>	.	.	1 „ 0 „
3. <i>Pteronites</i> , <i>M'Coy</i>	.	.	2 „ 2 „
4. <i>Leiopteria</i> , <i>Hall</i>	.	.	21 „ 17 „
5. <i>Rutotia</i> (new genus), <i>de Koninck</i>	.	.	11 „ 10 „
6. <i>Pachypteria</i> (new genus), <i>de Koninck</i>	.	.	1 „ 0 „
7. <i>Streblopteria</i> , <i>M'Coy</i>	.	.	18 „ 15 „
8. <i>Aviculopecten</i> , <i>M'Coy</i>	.	.	59 „ 38 „
9. <i>Entolium</i> , <i>Meek</i>	.	.	5 „ 4 „

## LIMIDÆ—

<i>Limatulina</i> (new genus), <i>de Koninck</i>	.	.	6 „ 5 „
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## In an Appendix—

<i>Pachydomus</i>	.	.	1 „ 1 „
<i>Edmondia</i>	.	.	1 „ 1 „
<i>Sanguinolites</i>	.	.	1 „ 1 „
<i>Cypriocardella</i>	.	.	1 „ 1 „
<i>Protoschizodus</i>	.	.	1 „ 1 „

—making a grand total of 310 new species.

Of the whole number of species described 262 are stated to be more or less rare, and 35 species are founded on single or incomplete specimens. Seven new genera are instituted for species which had previously been referred to some already described.

1886. A full and copious list of the fossils of the Carboniferous series in Northumberland is contained in chap. xiv of the “Materials for a Palæontology of Northumberland,” of Professor Lebour’s ‘Outlines of the Geology of Northumberland and Durham,’ second edition, 1886, pp. 108—128. The fossils are given in lists from each bed, but no new species are described; several have only the genus indicated, the species being new or not determined.

1887. In the second edition of “The Geology of the Carboniferous Limestone,



Yoredale Rocks, and Millstone-grit of North Derbyshire," 'Mem. Geol. Surv.,' Appendix I, is a list of the Carboniferous Limestone fossils, revised and added to by G. Sharman and E. T. Newton. A table is given in parallel columns showing the various localities at which each fossil occurs, but no horizons are indicated. A special column is given to the occurrences of the fossils in the Carboniferous Limestone of Staffordshire for the sake of comparison. No new forms are noted.

1888. On the 8th of December, 1887, John Young, LL.D., read a paper before the Geological Society of Glasgow, published in the 'Transactions,' vol. viii, part ii, 1888, p. 291, entitled "Notes on the Scottish Carboniferous Genera of the Molluscan Family Anatinidæ." He refers *Myacites*, *Leptodomus*, *Sanguinolites*, *Edmondia*, and *Cardiomorpha* to this family, and he discusses at some length the affinities of each. The genus *Sedgwickia*, though not occurring in Western-Scottish Carboniferous beds, is also mentioned and referred to the same family. He remarks on the large number of species which have been described and named, and thinks that a careful review would very greatly curtail the list.

1888. A complete list of the genera and species of British Carboniferous Lamellibranchs, with, in certain cases, synonyms, is contained in the 'Fossils of the British Islands;' vol. i, "Palæozoic, with Appendix brought down to end of 1886," by Robt. Etheridge, sen. No localities are mentioned, but references are given in almost every case. No new species or genera are described.

1888. In the 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1888, is a paper by C. R. Keyes, "On the Fauna of the Lower Coal-measures of Central Iowa." Nine Lamellibranchs are enumerated, pp. 232—4, but no new ones are described.

1889. In S. A. Miller's 'North-American Geology and Palæontology,' dated 1889, is a brief classification of the American rocks, including the Carboniferous, and a full list of the Palæozoic fossils of North America, arranged with their genera and species alphabetically, under the sub-kingdoms, with the synonyms printed in italics. Whenever possible a woodcut is given of the type species, and references are given to the original publication in which each species was described or figured. A previous volume was published in 1877 by this author, entitled 'The American Palæozoic Fossils.' This work is quoted by de Koninck.

1890. Mr. John Ward, in his paper on the "Geology of the North Staffordshire Coal-fields," 'Transactions of the North Staffordshire Institute of Mining and Mechanical Engineers,' vol. x, gives lists of the marine Lamellibranchs which occur in two bands, one above the Gin Mine or Golden Twist Coal, and the other above the Bay Coal of Longton; and also notes *Ariculopecten papyraceus* from Yoredale and Coal-measure beds, *A. alternatus*, *A. fibrilosus*, and *Posidomonya Gibsoni*, from Yoredale beds, and *Schizodus* from below the Four-foot Coal, Werrington.

*Anthracomya lanceolata* is erroneously described as *Modiola lithodomoides*,

p. 130, and a description by R. Etheridge, sen., of a new shell, *Sanguinolites granulatus*, is given with a figure, p. 127, pl. i, fig. 12.

1891. In a paper "On some *Estheriæ* and *Estheria*-like Shells from the Carboniferous Shales of Western Scotland," in vol. ix, p. 85, of the 'Transactions of the Geological Society of Glasgow,' read on March 13th, 1890, T. Rupert Jones refers certain shells from Arden, near Glasgow, and Dalry, Ayrshire, which he had previously described as *Estheria punctatella* to *Posidonomya*.

1890. Vol. viii of the 'Geological Survey of Illinois' contains A. H. Worthen's descriptions (pp. 107—133) and the figures of numerous Carboniferous Lamelli-branchiata which had been recorded in 'Bulletin of the Illinois State Museum of Natural History,' No. 2, 1884. The following species have been named mostly by Worthen; those described as new are marked.\*

<i>Leptodomus?</i> <i>magnus</i> .	* <i>Lima</i> <i>Chesterensis</i> .
<i>Schizodus</i> <i>Varsoviensis</i> .	<i>Edmondia</i> <i>Varsoviensis</i> .
— <i>Nauvoensis</i> .	— <i>Illinoiensis</i> .
— <i>depressus</i> .	<i>Clinopistha</i> <i>radiata</i> , Hall, sp.
— ? <i>circulus</i> .	* <i>Macrodon</i> <i>Sangamonensis</i> .
* — <i>Ulrichi</i> .	<i>Pleurophorus</i> <i>Chesterensis</i> .
* — <i>Randolphensis</i> .	— <i>minimus</i> .
<i>Pinna</i> <i>Sancti-Ludovici</i> .	— <i>Monroensis</i> .
* <i>Conocardium</i> <i>Parrishi</i> .	<i>Modiola</i> <i>Illinoiensis</i> .
<i>Aviculopecten</i> <i>Orestes</i> .	<i>Cardiomorpha?</i> <i>Pellensis</i> .
— <i>Niotensis</i> .	<i>Bakevella</i> <i>Illinoiensis</i> .
— <i>Monroensis</i> .	<i>Myalina</i> <i>Monroensis</i> .
— <i>Talboti</i> .	<i>Nucula</i> <i>Illinoiensis</i> .
— <i>Elsahensis</i> .	<i>Aviculopinna</i> <i>Illinoiensis</i> .
— <i>Chesterensis</i> .	<i>Sanguinolites?</i> <i>multistriatus</i> .
— <i>spinuliferus</i> , M. and W.	— ? <i>Burlingtonensis</i> .
* — <i>Mazonensis</i> .	— <i>Randolphensis</i> .
* — <i>Hardinensis</i> .	<i>Solenomya</i> <i>Varsoviensis</i> .
* — <i>Mac-Whorteri</i> .	— <i>Monroensis</i> .
<i>Aviculopecten</i> <i>Colleti</i> .	— ? <i>Iowensis</i> .
— <i>Edwardsi</i> .	<i>Allorisma</i> <i>Illinoiensis</i> .
— <i>Menardi</i> .	— <i>elongata</i> .

1891. On December 8th, 1891, Mr. George Wild read a paper before the Manchester Geological Society, subsequently published in the 'Transactions' of that body, vol. xxi, 1892, p. 364, on "The Lower Coal-measures of Lancashire: Organic Remains, Sections of Seams, and Probable Mode of Formation." At the end of this paper is a catalogue of fossils, in the cabinet of the author, from the Lower Coal-measures of the North and East Lancashire Coal-field. Figures are given, pls. ii and iii, of the following Lamellibranchs:

*Nucula*, sp.? (*Schizodus*.)

*Anthracosia*, new angular species. (*Schizodus*.)

*Posidonia Gibsoni*.

*Solemya primæva*.

*Aviculopecten*.

1891. In the 'Proceedings of the Academy of Natural Sciences of Philadelphia' for 1891, p. 242, is a second paper by C. R. Keyes, on "Fossil Faunas in Central Iowa." Several Lamellibranchs are enumerated from Carboniferous beds, but no new forms are described.

1892. In the 'Proceedings of the Royal Physical Society of Edinburgh,' vol. xi, p. 244, is a paper by J. G. Goodchild, entitled "Notes on Carboniferous Lamellibranchs," in which he confirms the fact that the Nuculoid shells from Carboniferous beds possess a distinct cartilage-pit, and therefore cannot be referred to *Ctenodonta*, Salter. He also points out the absence of a pallial sinus in some of these shells.

Another paper, at p. 245, in the same volume deals with the genus *Allorisma*, a diagnosis of which is given, and it is stated that a pallial sinus is seen in at least six species.

1892. Professor W. Amalizky's work, "Ueber die Anthracosien der Permformation Russlands," in 'Palæontographica,' Band xxxix, 1892, p. 125, *et seq.*, deals only with fresh-water forms, which he classes under the following genera :

*Carbonicola*, *M'Coy*.

*Anthracosia*, *King*.

*Palæomutela*, *Amalizky*.

*Oligodon*, *Amalizky*.

*Naiadites*, *Dawson*.

1892. Professor X. Stainier's paper, "Matériaux pour la flore et le faune du houiller de Belgique," published in vol. xix of the 'Annales de la Société Géologique de Belge,' 1892, p. 333, gives tabular lists of the localities and horizons at which fossil Lamellibranchs are found, many marine forms being included. A second note on the "Faune du Houiller" was issued in the volume for 1892-3, tome xx, p. 43; and a third note was published in the 'Bulletin Société Belge de Géologie, &c.,' tome vii, 1893, p. 135, with further details of the occurrence of Carboniferous Lamellibranchiata in the Belgian coal-bearing strata.

1894. In a paper, "Ueber die systematische Stellung der Trigoniden und die Abstammung der Nayaden," by von S. Frh. V. Wöhrman, in the 'Jahrbuch der k.-k. geologischen Reichsanstalt,' Band xliii, for 1893, the affinities of *Schizodus* (p. 7), *Palæomutela* (p. 16), and *Palæoneilo*, p. 18 (*Tellinomya*), are discussed.

1893. Vol. vii, 'Report of the Geological Survey of Ohio,' contains, chap. iii, a section on the "Palæontology of Ohio," by R. P. Whitfield. *Pinna Marvillensis*, *Allorisma Andrewsii*, and *Allorisma Marvillensis* are here figured and redescribed.



Chap. iv consists of "Observations upon the so-called Waverley Group of Ohio," by Prof. C. L. Herrick. Lists of fossil Lamellibranchs are given from various horizons of this group, and figures of thirty-three new forms are given without a word of description.

1894. Mr. J. F. Whiteaves described and figured some new large Coal-measure fossils as *Asthenodonta Westoni* from the South Joggins. They much resemble *Anodonta Jukesii* from the Kiltorcan beds in size and appearance ('Proc. and Trans. Roy. Soc. Canada,' vol, xi, sec. iv, p. 21, 1894).

1894. In the 'Proceedings of the Royal Physical Society of Edinburgh,' vol. xii, p. 356, is a paper by Mr. Goodchild, entitled "Notes on Carboniferous Lamellibranchs," which was read on March 21st, 1894. He discusses the generic affinity of *Venus parallela*, Phillips, and refers it to *Cypricardella*, Hall. In the latter part of his paper he discusses the bathymetrical distribution of the Carboniferous Lamellibranchs.

1894. Part 2 of vol. v of the 'Geological Survey of Missouri' contains a section, chap. xii, on "Carboniferous Lamellibranchs," by C. R. Keyes. Many species are redescribed and refigured, and the following new form is described and figured—*Aviculopecten fasciculatus*. A valuable list of spurious and doubtful species is given at the end.

*Some Additional Publications and Papers.*

1868. Figures of *Avicula* and *Nucula*? from the Coal strata, without specific names, are given at p. 833 of the 'Geology of Pennsylvania,' vol. ii, pt. 2, by G. H. D. Rogers.

1868. In vol. ii, p. 81, of the 'Transactions of the Academy of Science of St. Louis' is a second paper by Swallow, entitled "Descriptions of some New Fossils from the Carboniferous and Devonian Rocks of Missouri," in which the following Carboniferous Lamellibranchs are described for the first time:

<i>Allorisma antiqua.</i>		<i>Cypricardia? occidentalis.</i>
<i>Cypricardia? Pikensis.</i>		<i>Pecten Broadheadii.</i>
— ? <i>Wheeleri.</i>		— <i>Missouriensis.</i>
— ? <i>Shumardiana.</i>		<i>Avicula magna.</i>

1884. An important work, 'The Natural History of New York: Palæontology,' vol. v, part 1, 1884, by James Hall, contains descriptions and figures of Lamellibranchs of the Devonian age. Although not referring directly to Carboniferous fossils, some of the new genera established by the author have been adopted by L. de Koninck in his great work on the 'Calcaire Carbonifère de Belge,' viz. *Cypricardella* and *Leiopteria*.

1892. In the 'Seventeenth Annual Report of the Department of Geology, &c.,



Indiana,' pp. 701—704, pl. xx, figs. 1—10, S. A. Miller describes and figures from Carboniferous beds—

*Schisodus Harii*, n. sp.

*Cypricardella Gorbyi*, n. sp.

*Aviculopecten sculptilis*, n. sp.

*Pterinopecten Sedaliensis*, n. sp.

*Grammysia Blairi*, n. sp.

*Conocardium Indianense*, n. sp.

## DESCRIPTION OF SPECIES.

### *Family MYTILIDÆ.*

Shells elongate, wedge-shaped, narrow, and tumid anteriorly, expanded and flattened posteriorly. Pallial impression entire. Adductor muscle-scars two or more in each valve.

*Observations.*—The family Mytilidæ were well represented in palæozoic times, several well-defined genera having already come into existence.

M'Coy, 'British Pal. Fossils,' p. 265, classed together a number of genera under the family Mytilidæ, which have not, however, been generally recognised as having much affinity by subsequent investigators. For instance, his family Mytilidæ includes *Mytilus*, *Lithodomus*, *Modiolopsis*, *Dreisena*, *Hippopodium*, *Pinna*, *Dolabra*, *Myaphoria*, *Anodontopsis*, *Lyrodesma* (*Actinodonta*), *Clidophorus*, *Tellinomya*, *Orthonotus*, and apparently (p. 499) *Edmondia*. This very heterogeneous group cannot be retained. The same author refers the genus *Myalina* with *Ambonychia* to the *Aviculidæ*, and this classification is accepted by many, but I advance reasons for placing these two genera in the *Mytilidæ*, though in certain characters they have a slight affinity with the *Aviculidæ*.

*Genus MODIOLA, Lamarck, 1801.*

List of the synonyms in writings of various authors on Carboniferous Mollusca.

Non *MODIOLA*, *Fleming*, 1825. *Edinb. Phil. Journ.*, vol. xii, p. 246.

— — *Phillips*, 1836. *Geol. of Yorkshire*, vol. ii, p. 209.

— — pars, *Sowerby*, 1840. *Trans. Geol. Soc.*, ser. 2, vol. v, p. 491.

— — *Portlock*, 1843. *Report Geology Londonderry*, p. 424.

— — pars, *Morris*, 1843. *Catal. Brit. Foss.*, p. 91; 1854, p. 209.

— — *M'Coy*, 1844. *Synopsis of Carboniferous Fossils of Ireland*, p. 74.

— — pars, *Brown*, 1849. *Illustr. Fossil Conch. Great Britain*, p. 173.

*MYTILUS*, pars, *de Ryckholt*, 1847. *Mélanges paléontologiques*, pt. 1, p. 132; 1853, pt. 2, p. 87.



Captain Brown described and figured a large number and variety of shells under the name *Modiola*, quoting the references of previous writers. He included several forms of *Anthracomya* in that genus.

De Ryckholt included all the Mytiliform shells from the Carboniferous beds of Belgium in the genus *Mytilus*; of these *M. Cordolianus*, *M. fabalis*, *M. apicicrassus*, and *M. palmatus* are referred to *Modiola* by de Koninck.

Baily referred a specimen from the Carboniferous shale of Foynes Island to *Myalina*, but I have not been able to retain it in this genus, as the shell has not a striated hinge-plate, and possesses an anterior lobe. I have considered this term as a synonym of M'Coy's *Modiola megaloba*.

De Koninck described and figured eighteen species of *Modiola* in his great work (*op. cit.*, pp. 174—180), four of which had been described previously by de Ryckholt as *Mytilus* (mentioned above), and one by himself in a previous work as *Cardiomorpha*. The new species are—

<i>Modiola princeps.</i>	<i>Modiola gibberosa.</i>
— <i>fusiformis.</i>	— <i>reniformis.</i>
— <i>lacryma.</i>	— <i>macrocephala.</i>
— <i>impressa.</i>	— <i>cuneiformis.</i>
— <i>Meeki.</i>	— <i>spathuliformis.</i>
— <i>arguta.</i>	— <i>? annulosa.</i>
— <i>? emaciata.</i>	

On careful examination of the whole series of specimens now in the Natural History Museum, Brussels, I am convinced that *M. princeps* and *M. fusiformis* are the same shell as *M. lingualis*, now referred to *Lithodomus*, and I am doubtful whether the *Modiola Cordoliana* may not also belong to the same species. The type is somewhat crushed, and this may account for the flatter and more expanded posterior end. The test is well preserved, and this may account for the accentuation of the lines of growth. A second specimen has even a closer resemblance to the British form.

Of the remainder, the types of three, *M. arguta*, *M. cuneiformis*, and *M. Meeki*, do not appear to be in the collection. *M. apicicrassa*, de Ryckh., appears to me to be in too fragmentary a condition to be recognised and to serve as a type, and I doubt, with de Koninck, whether *Modiola annulosa* is correctly referred to that genus. *M. fabalis* gave me the idea that it was the young of *Posidoniella vetusta*, which it most resembles in the undulations which ornament its surface.

Whether or not the shells which I still retain in *Modiola* are correctly referred to that genus may be considered somewhat doubtful in the absence of any knowledge of the internal anatomy of the shell.

Portlock's *Modiola Macadamii*, var. *lata*, has a curious internal ridge, which passes downwards from the umbo to the inferior border in the anterior part of



the shell (which is shown as a groove in casts). This is a feature not usually met with in the genus *Modiola*, but is seen in other Carboniferous bivalves, *e. g.* the *Avicula Hendersoni* of Robert Etheridge, jun. M'Coy's *Modiola divisa* also had this peculiar structure, and the specific name was given to it on that account; but I have, however, stated above that I consider it probable that these two forms will be found to be the same.

Only four Carboniferous shells have been referred to *Modiola* by American palæontologists, two of which, in a former Monograph, I thought probably belonged to *Naiadites*.

Many of the elongate, narrow, Modioliform shells occurring in the Jurassic beds agree rather in shape with *Lithodomus* than with *Modiola*, to which they have always been referred, it having been the custom to place all such shells in the latter genus. Probably this has been due to the desire to establish the rock-boring habits of a shell before classifying it with a group in which that mode of living is characteristic. Habits, however, are a matter of environment and evolution, of course depending on anatomical construction, but should not, I think, be used as a basis for classification.

MODIOLA PATULA, M'Coy, 1844. Plate I, figs. 1, 2, 2 a, 2 b.

MODIOLA PATULA, M'Coy, 1844. Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 75, pl. xiii, fig. 13.

MYTILUS PATULUS, d'Orbigny, 1850. Prodrome de Paléontologie, vol. i, p. 134.

? — PERNELLA, de Ryckholt, 1847. Mélanges paléontologiques, part 1, p. 144, pl. viii, figs. 20, 21.

MODIOLA PATULA, Bigsby, 1878. Thesaurus Devonico-Carboniferus, p. 309.

— — R. Etheridge, 1888. British Fossils, vol. i, Palæoz., p. 285.

*Specific Characters.*—Shell transversely elongate, obliquely spathulate, obliquely gibbose. The anterior end is almost obsolete and obtusely pointed. The lower margin, convex in outline at first, soon becomes slightly concave, until the oblique convexity of the shell meets it, when it again becomes convex downwards. The posterior border is obtusely rounded, and there is no angle at any part of its extent, but it meets the lower margin with a more obtuse curve than it makes above with the superior border. The hinge-line is almost straight, and equal in length to almost one-half the extreme antero-posterior measurement of the shell; posterior to the hinge the upper border gently curves downwards, and passes imperceptibly into the posterior.

The umbones are anterior but not quite terminal, small, remote from the



edge of the shell. The surface of the shell is divided into two portions by an oblique swelling, which passed downwards and backwards from the umbo to the lower margin near its junction with the posterior border. The lower edge of this swelling is the most marked, and is almost angular in its middle and posterior portions. Below the swelling the shell is compressed and hollowed, so that this part of the surface is placed at a considerable angle with the rest of the shell. The byssal notch was probably at the centre of the lower border, judging from the constriction on the surface of the shell. Above the swelling the shell arches by a gradual curve into the upper and posterior borders, the curve being very rapid in front, and gradually lessening from before backwards, the convexity of the shell diminishing at the same time, but with the smaller convexity the valves become expanded from below upwards.

The interior is at present unknown.

The exterior is marked by numerous fine lines of growth, starting from the anterior end, where they are much crowded, but becoming rapidly and widely separated as they pass backwards over the shell, the anterior ones being as much as half an inch apart, but the distance between each line gradually diminishes from before backwards. The interspaces are filled with very fine lines, so that the markings appear to be subimbricate, from the separation of the secondary lines of growth into bundles by the primary. All the bundles and lines of growth have the same contour as the margins of the shell, and when they reach the upper border are rapidly crowded together and terminate in the hinge-line. The shell appears to be very thin.

*Dimensions.*—Fig. 2, Pl. I, measures—

Antero-posteriorly 80 mm.

Dorso-ventrally 40 mm. estimated in incomplete specimen.

The left valve is 20 mm. deep.

*Localities.*—The Carboniferous Limestone of Cork, Millicent.

*Observations.*—The original specimen from which M'Coy described this species was probably in the collection of Dr. Haines, of Cork, as the words "communicated by Dr. Haines, of Cork," are appended to the description. At any rate the specimen is not in the Griffith collection in the Museum of Science and Art, Dublin. The specimen I figure is now in the collection of Mr. Joseph Wright, of Belfast, who informs me that he obtained it from the collection of Dr. Haines. It cannot be the original of M'Coy's figure as is obvious from the most cursory comparison; it is satisfactory, however, that the specimens now figured come from the same locality as the original. M'Coy points out that "the broad spathulate form and want of posterior angle . . . distinguish this from every other Palæozoic species." This is so, at any rate, as far as Carboniferous species are concerned, all the others having a more or less angulated posterior

border; but in addition the surface-marking is very typical. The subimbricate appearance and demarcation of the lines of growth into bundles is not met with in any other species.

The original specimen is smaller than the one I figure, measuring only about 60 mm. in its antero-posterior diameter, and the anterior end is enveloped in matrix; but it shows the characteristically shaped posterior end, and the subimbricated, widely separated primary lines of growth dividing the secondary lines into bundles.

There is a well-marked specimen in the Griffith Collection of the Museum of Science and Art, Dublin, evidently named by M'Coy, and doubtless forming part of the material on which he founded the species, for that there was more than one specimen is at any rate probable, because, although the anterior end of the figured specimen is not exposed, he states, "Anterior end forming an obtuse lobe before the beak." It was not M'Coy's practice to give more than one figure of any of his species, and he seldom gives more than one view of any specimen, except mere outlines to show contours, or magnified drawings of surface ornamentation.

It is a matter of regret that at present no specimens have been met with which reveal any details of the hinge-apparatus or muscular scars.

I think it very probable that *Mytilus pernella* of de Ryckholt belongs to M'Coy's *Mod. patula*. The peculiar surface-marking is faithfully depicted in de Ryckholt's figures, and the general tumidity of the shell is well indicated. His description is "Coquille épaisse, allongée, ovale, un peu arquée, renflée; sa surface est couverte de gros plis saillants, inégalement espacés, sur lesquels passent de fines lignes d'accroissement, &c." This species, obtained from Visé, is not, however, noted or even given as a synonym by de Koninck in his last work, and it is probable that the shell on which the description was based has entirely disappeared.

This species would appear to have a very local distribution, being only known from the Carboniferous Limestone of the south of Ireland, and, if my surmise is correct as to the true character of *M. macrocephala*, very rarely in Belgium in stage ii of the Carboniferous Limestone.

MODIOLA MEGALOA, M'Coy, 1844. Plate II, figs. 5—10.

MODIOLA MEGALOA, M'Coy, 1844. A Synopsis of the Characters of the Carboniferous Fossils of Ireland, p. 75, pl. xi, fig. 31.

MYALINA FOYNESIANA, Baily, 1860. Memoirs of the Geological Survey of Ireland, Explanation of Sheet 142, p. 13, fig. 4.

MODIOLA MEGALOBA, *Bigsby*, 1878. *Thesaurus Devonico-Carboniferus*, p. 389.

— — *Etheridge*, 1888. *British Fossils*, vol. i, Palæoz., p. 285.

MYALINA FOYNESIANA (pars), *Etheridge*, 1888. *Ibid.*, p. 286.

*Specific Characters.*—Transversely and ovately triangular, of moderate size. The anterior portion of the shell is represented by a small tumid lobe, well marked off from the rest of the surface by an oblique constriction; the anterior border is bluntly rounded, and passes by a gradual curve into the inferior border, which is directed obliquely downwards and backwards, and almost straight, making an acute angle with the hinge-line. The posterior border is obliquely truncated above and rounded below in young specimens, but in larger ones less truncate and more rounded.

The hinge-line is straight, equal in length to quite two-thirds of the greatest length of the shell, and joins the posterior border at an obtuse angle. The umbones are anterior, swollen, acute, but not raised above the hinge-line, apparently contiguous, not terminal. Proceeding backwards and downwards obliquely from the umbones is a gibbosity, narrow but convex, transversely at first, but expanding as it passes downwards, and in the lower third it becomes flattened. The anterior slope of this ridge is rapid, and it is bounded in front by the sulcus which marks off the anterior part of the shell, the sulcus being almost linear above, but becoming broader and deeper as it approaches the margin, and having an oblique direction. Posteriorly and upwards the shell is gradually compressed and expanded into its borders.

*The Interior.*—The hinge-line is non-striate, and has the indication of a longitudinal groove for an internal ligament just within the hinge-edge. The anterior adductor muscle-scar is small, deep, and marginal below; and in front of the beak the posterior adductor scar is large, shallow, ovate, and is placed a short distance from the margin at the posterior superior angle.

The pallial line is simple and remote from the margin. The internal surface is almost smooth, but has, below and behind, obscure concentric sulci.

*Exterior.*—The surface of the shell is covered with fine and close lines of growth, which have a direction parallel to the borders. The left valve is the more convex. Shell thin.

*Dimensions.*—Fig. 7, Pl. II, measures—

Antero-posteriorly . . . . .	30 mm.
Dorso-ventrally at end of hinge-line . . . . .	18 mm.
Elevation of valve, about . . . . .	5 mm.

*Localities.*—The Coombs Limestone, Redesdale, and Sillo Burn, half-mile north of Netherwood, Northumberland. Coal-measure shales, Foynes Island, co. Limerick. In shales on the shore near Kinghorn, Fife; very small form.



*Observations.*—The original type of M'Coy's species has unfortunately completely disappeared, but the specimens which I refer to the same name now have a very close resemblance to the original figure. Little can be made out from M'Coy's description, which is self-contradictory and meagre. It is as follows:—“Transversely ovate, gibbous, beaks small, subterminal. *Anterior lobe exceeding half the length of the shell, defined by a strong sulcus from the beak.* Hinge-line two-thirds the length of the shell, angulated.” The italics are mine. The figure does not show such an anterior lobe as here described, but apart from this curious inaccuracy, the description tallies well with the shells now described, with the exception that the Northumbrian specimens are much larger. This shell appears to be a true *Modiola*, having the groove for the internal ligament, and a rounded, non-striate hinge-margin, thus differing from *Naiadites*, to which genus it has a very great superficial resemblance; indeed, it would be impossible to separate it from this genus, except from the hinge and internal characters, and the associated fossils. The general shape at once separates it from *Myalina*. M'Coy says in his remarks, “This is one of the very few instances in which the true anteriorly lobed, recent and Oolitic form of *Modiola* has been found in the older rocks.”

Fortunately the slab of limestone obtained by Mr. John Dunn, of Redesdale, from the Coombs Quarry contains four specimens: one, an imperfect interior, Pl. II, fig. 8, happily just giving enough detail of the hinge-structure for correct generic identification; one, a good cast, Pl. II, fig. 7, imperfect at the anterior end; and two specimens, Pl. II, figs. 5 and 6, of left valves showing surface markings and general shape, while another specimen, Pl. II, fig. 9, shows the anterior end. An undoubtedly marine fauna is contained in this bed of limestone. The Irish locality is not given in M'Coy's work, and I am not at present aware of the occurrence of this species anywhere else in Great Britain.

The example from Foynes Island, figured by Baily but not fully described, named *Myalina Foynesiana*, is of the same species as the Northumbrian shells. There are two examples on the same slab,—one, the cast of two valves, lying flat open; the other, the interior of the shell. The striated hinge-plate and terminal umbones of *Myalina* are conspicuously absent, so that the shell was incorrectly referred to that genus. The anterior end is incomplete, but the casts of the umbones are preserved, and have not the two processes representing the pit-scars of *Naiadites* on them. The posterior adductor scar is very finely shown in this specimen, Pl. II, fig. 10, which I am able to figure by the kind permission of the Director-General of the Geological Survey, Sir A. Geikie. The specimen is in the Collection of the Irish Geological Survey. This shell is associated in the shales with *Aviculopecten*, *Posidonomya*, and *Goniatites*.



MODIOLA MACADAMII, *Portlock*, 1843. Plate II, figs. 20—22.

			MODIOLA MACADAMII, var. ANGUSTA, <i>Portlock</i> , 1843. Report Geol. Londonderry, &c., p. 432, pl. xxxiv, fig. 13.
Non	—	—	var. ELONGATA, <i>Portlock</i> , 1843. Ibid., fig. 14.
—	—	—	var. LATA, <i>Portlock</i> , 1843. Ibid., fig. 15.
—	—	—	<i>Morris</i> , 1843. Catalogue of British Fossils, p. 91.
—	—	—	<i>M'Coy</i> , 1844. Synopsis of the Characters of the Carb. Limestone Fossils of Ireland, p. 75.
—	—	—	<i>Brown</i> , 1849. Foss. Conch. p. 175, pl. lxi***, fig. 14.
—	—	—	Ibid., figs. 15, 16.
MYTILUS	—	—	<i>de Ryckholt</i> , 1853. Mélanges paléontologiques, part 2, p. 87.
—	MODIOLA	—	<i>Baily</i> , 1875. Figures of Characteristic British Fossils, p. 114, pl. xxxix, fig. 6.
—	—	—	<i>Kinahan</i> , 1878. Manual Geol. Ireland, pl. iii, fig. 4.
—	—	—	<i>Bigsby</i> , 1878. Thesaurus Devonico-Carboniferus, p. 309.
—	—	—	var. ANGUSTA, pars, <i>Etheridge</i> , 1888. British Fossils, vol. i, Palæozoic, p. 285.

*Specific Characters.*—The shell is small but lengthened, narrow, and convex, and must approach to a cylindrical form when both valves are together. Apparently equivalve. The anterior end is almost obsolete, and has a bluntly pointed extremity, moderately convex. The inferior border commences in front by curving downwards from its junction with the anterior, and then becomes straight, making with the hinge-line an angle of about  $15^{\circ}$ ; then it passes into the posterior border in a bluntly rounded curve.

The posterior part comprises by far the greater portion of the shell, and is expanded and flattened. Its border is at first obliquely truncate from above downwards and backwards, and then bluntly rounded to meet the inferior margin. The hinge-line is straight, and equal to about half of the greatest length of the shell in extent, forming behind a very obtuse angle with the posterior border.

The umbones are almost anterior, but apparently not quite terminal; very inconspicuous. Passing downwards and backwards from the umbones is a very gibbose oblique swelling, which becomes rapidly expanded and lost on the surface of the shell as it approaches the postero-inferior angle, the upper border of the swelling being the more accentuated, above which the shell is at once compressed and expanded upwards.

The interior has not been observed.

*Exterior.*—The surface of the shell is smooth, but under the microscope very fine concentric lines of growth are apparent. Shell very thin.

*Dimensions.*—The specimen marked as the type, Pl. II, fig. 20, though imperfect, measures—

Greatest antero-posterior length . . . . .	13 mm.
Greatest dorso-lateral length . . . . .	5 mm.

*Localities.*—Ireland: Ballynascreen, co. Derry; Tyrone.

*Observations.*—In the original description of the species *Modiola Macadamii* (*op. supra cit.*) General Portlock gave names to three varieties, without enunciating the specific characters or types. He states, p. 432, "The three forms figured . . . . . seem in themselves sufficiently distinct for specific separation, but there are so many intermediate gradations, and so much variation from age and the condition of the specimens that I shall unite them together as merely varieties of one species." In his remarks on *M. Macadamii*, var. *angusta*, he says, "This diverges as much from the ordinary form in one direction as fig. 15 (*M. Macadamii*, var. *lata*) does in another;" and this makes it appear that he regarded neither of the three varieties as the specific type. This omission is unfortunate, as no description or figure exists of such, and therefore it has been necessary to regard Portlock's variety *angusta* as the type, this form being the first one of the three on page 432 of Portlock's work. The block on which the figured specimen of *M. Macadamii*, var. *angusta*, occurs is of totally different lithological character, and contains a different fauna from those in which the other described varieties were found,—the first-named shell occurring with a typically marine fauna, containing in abundance *Nuculana* (*Leda*) *attenuata*, *Avicula Hendersoni*? R. Etheridge, jun. (*Modiola divisa*, M'Coy), and Ostracoda; while with the other varieties only some other forms of Ostracoda are found. In the Explanatory Memoir of Sheet 25 of the Geological Survey, p. 22, the shells are said to occur with *Spirorbis*, *Helodus*, *Leperditia Okeni*, and plant remains; and in two others with *Orthoceras*, *Euomphalus Cyrtoceras*, and *Syringopora*.

I am of opinion that this form is specifically distinct from the other two; both from the general appearance and the associated fossils, which indicate a more truly marine condition. From the fact that in most of the localities the shells were of estuarine or brackish-water habitat, it seems to me probable that the vars. *lata* and *elongata* were associated with them; and that the form *angusta* only occurred in the true marine beds.

I have therefore retained the name *Modiola Macadamii* for the variety *angusta*, and shall describe the other forms under the names *Modiola lata*, owing to a pre-occupation of the name *M. elongata* by Professor Phillips ('Geol. Yorkshire,' part 2): I can see no essential difference between them.

Immediately after the description of the three forms of *M. Macadamii*, Portlock described another form as *Modiola subparallela*, on which he remarks, "Though this

appears so very distinct a form from *M. Macadamii*, I am disposed to think that they all merge one into the other; but for the advantage of distinguishing the shell in other localities I have separated this variety, so strongly marked, as a distinct species." The figures given are all very good, and fortunately the original types are all preserved in the museum of the Geological Survey, Jermyn Street. An examination of *M. subparallela* at once demonstrates the fact that this shell does not belong to that genus, but from its general shape and contour closely resembles *Anthracomya* (Salter), to which genus I have referred the shell, Pal. Soc. 'Monograph on Carbonicola, Anthracomya, and Naidaites,' Appendix, p. 177, 1896.

M'Coy described only one form as *Modiola Macadamii*, stating in his remarks, "This is a very variable shell." Unfortunately no figures were given, but from the description that the shell was "marked with rather distant, irregular, deep, concentric striæ," it is probable that he considered Portlock's var. *elongata* as the type, but nothing is said on the subject; and the form depicted by the terms "transversely ovate, gibbous," can hardly be applied to the species under description, but he gives *M. angusta* and *M. subparallela* as distinct species.

MODIOLA LATA, *Portlock*, 1843. Plate II, figs. 23—27.

MODIOLA MACADAMII, var. ELONGATA, *Portlock*, 1843. Report Geology London-derry, &c., p. 432, pl. xxxiv, fig. 14.

— — var. LATA, *Portlock*. Ibid., fig. 15.

— — *M'Coy*, 1844. Synopsis of the Characters of the Carb. Limestone Fossils of Ireland, p. 75.

-- — (pars), *Brown*. Fossil Conch., 1849, p. 175, pl. lxi\*\*\*, figs. 15 and 16.

— — — var. ELONGATA, *Etheridge*, 1888. British Fossils, vol. i, Palæoz., p. 285.

*Specific Characters*.—Shell transversely and obliquely ovate, moderately swollen, especially in front. The anterior end is very short, regularly gibbose, and bluntly rounded in front, with a narrow dorso-ventral diameter. The inferior border is almost straight, and directed downwards and backwards, becoming bluntly rounded as it passes into the posterior border, which is very obliquely truncate above but rounded below. The hinge-line is straight, and equal in length to more than one-half the greatest diameter of the shell. It forms with the posterior border a very obtuse angle, and is raised behind. The umbones are anterior, blunt, but not terminal, remote from the hinge-line, from which they are separated by a distinct fold, which is narrow in front and becomes wider behind. The shell is obliquely swollen, the swelling becoming gradually expanded and flattened as it passes from before backwards, the upper edge being acute for a short distance from the umbo; above this



swelling the shell becomes compressed rapidly into the hinge-line. There appears to be no constriction anterior to the swelling, nor any indication of a byssal sinus in the type specimen, which has the test preserved, but this character is markedly present in casts.

*Interior.*—The anterior adductor scar is almost marginal, fairly large and round, quite anterior to the umbo. It is bounded behind in casts by a deep groove which passed downwards and obliquely backwards to the lower border, becoming shallower and broader *en route*. In casts the umbo is separated from the hinge-line by a distinct hollow, which expands and becomes shallower as it passes backwards. The interior of the umbo was smooth and acutely pointed. The positions of the posterior adductor and the pedal muscle-scars have not yet been exposed.

There is no groove along the hinge-line as in casts of *Anthracomya*, nor area for the internal ligament as in recent *Modiolæ*.

*Exterior.*—The surface is marked with fine raised thread-like striæ, fresh ones arising over the greatest gibbosity of the shell by bifurcation or intercalation. Posteriorly they are fewer, less raised, and farther apart, and often joining another. The direction of the striæ is parallel to the margins, and they all terminate in the hinge-line. On the flattened and compressed part of the shell above, and posterior to the umbonal swelling, the surface is almost smooth. The shell is thin.

*Dimensions.*—The type of *M. Macadamii*, var. *elongata*, Pl. II, fig. 26, measures—

Greatest antero-posterior diameter	.	30 mm.
Greatest dorso-ventral	„	18 mm.

The type of *M. Macadamii*, var. *lata*, Pl. II, fig. 25, measures—

Greatest antero-posterior diameter	.	32 mm.
Greatest dorso-ventral	„	20 mm.

*Localities.*—Derry, Ballynascreen, Tyrone; Lower Limestone-shales, Cultra, co. Down.

*Observations.*—Owing to the preoccupation of the name *Modiola elongata* by Professor Phillips, though that shell is a *Posidoniella*, I have been unable to retain it as the specific title of Portlock's shell. I am, however, not able to find any specific characters on which to separate Portlock's variety of *Modiola Macadamii*, var. *elongata*, from his var. *lata*, and have therefore retained that name for both shells. The apparent differences between the two types are due to the fact that the var. *elongata* possessed a well-preserved test; while var. *lata*, being a somewhat large shell, was mainly a cast, but unfortunately did not give much detail as to the internal anatomy; this want, however, was fortunately supplied by another specimen in the Geological Survey Collection, Pl. II, fig. 27, which showed many of the internal characters. One curious feature is the deep byssal groove in casts, all evidence of which is absent in the complete shell. This is shown to be due to an oblique ridge on the inner surface of the shell in fig. 23, Pl. II, from the Cultra beds. Portlock



speaks of his var. *lata* having "a flattened form, probably the result of pressure." This flattening is only apparent and not real, and is due to the larger size of the shell and the smooth surface of the cast.

This shell has somewhat the appearance of *Anthracomya*, from which it can be separated by the absence of the groove parallel to the hinge-line in casts.

There is also a superficial resemblance to *Naiadites*, from which it is separated by the absence of the characteristic pit-like, triple, anterior muscle-scars and the striated hinge-plate.

When young the shells are not so oblique, and are in proportion to their size more tumid, and have the anterior end more developed relatively to the rest of the shell, Pl. II, fig. 24. There is a fine slab from the Portlock Collection in the Geological Survey Museum, Jermyn Street, showing this species in all stages of growth; even when very young the internal ridge is conspicuous.

This species seems to be, as far as is at present known, confined to the Lower Limestone-shales of the North of Ireland, and to be associated with *Leperditia Okeni*, *Helodus*, and plant remains. It is doubtful whether it is therefore of marine habitat, and in this particular differs very markedly from *Modiola Macadamii*, which occurs with undoubtedly marine shells (*vide antea*, p. 64). The lithological character of the shales in which the two forms occur is very different, *Modiola lata* being found in brittle and soft marly shales, light grey in colour. De Koninck, in the remarks on his shell *Modiola macrocephala*, 'Faune de Calcaire Carbonifère de la Belgique,' p. 178, says of his species, "Elle a quelque ressemblance avec la *Modiola Macadamii*, var. *lata*, de J. E. Portlock, mais elle en diffère par sa grande taille et par sa forte épaisseur." The Belgian shell is so very much larger than the Irish specimen, measuring 70 mm. in length, 43 mm. in height, and 30 mm. in thickness, that I think there can be no connection between the two forms. De Koninck's species is founded on a single specimen from the Limestone of Waulsort.

MODIOLA TRANSVERSA, sp. nov., *Hind*. Pl. II, figs. 11, 12.

*Specific Characters*.—Shell small, transversely compressed, ovate, gibbose. The anterior end is small and obtusely rounded, the narrowest part of the shell dorso-ventrally. The inferior margin, directed backwards and slightly downwards, is straight, joining the anterior and posterior margins at either end with a regular blunt curve. The posterior border is regular and almost semicircularly rounded. The hinge-line is straight, equal in length to about two-thirds of the antero-posterior diameter of the shell. The umbones are small, anterior, pointed, and directed inwards, downwards, and forwards; not elevated above the hinge-line. Proceeding obliquely downwards and backwards is a blunt gibbosity, not well marked off from the rest of the shell. The swelling is most marked above. About the

centre of the inferior border an almost obsolete, broad, shallow constriction is visible. Behind, the shell is gradually compressed, especially above, and slightly expanded.

*Interior.*—The anterior adductor scar is large, marginal, situated just below and in front of the umbones, from which it is separated by a sulcus. The posterior adductor scar is round, and placed high up just below the termination of the hinge-line. In the cast there is an elongate sulcus along the edge, corresponding to a slight thickening in the edge of the shell, and no indications of striation.

*Exterior.*—The surface is covered with fine striæ and plicæ of growth more or less parallel to the contour of the shell.

*Dimensions :*

	Antero-posteriorly.	Dorso-ventrally.	Laterally.
Pl. II, fig. 12, measures	19 mm.	10 mm.	—
Pl. II, fig. 11 „	16 mm.	9 mm.	6.5 mm.

*Locality.*—In calcareous bullions in a bed of shale, several yards below the base of the Millstone-grit, Congleton Edge.

*Observations.*—I am unable to refer these little shells to any described species, and have therefore described them as new. They come from a bed described by the Geological Survey officers in the Memoir entitled ‘The Geology of the Country round Stockport, Macclesfield, Congleton, and Leck,’ p. 72, where a section is given showing the succession of Millstone-grit, Yoredale beds, and Carboniferous Limestone, the quarry being nearer the upper part of the so-called Yoredale beds. The *Modiolæ* are associated with a large and typical marine fauna—*Productus*, *Chonetes*, *Orthis*, *Streptorhynchus*, and with other Brachiopods, Lamellibranchs, Gasteropods, and Cephalopods. The species now described approaches *M. Macadamii*, but is more transverse and tumid, and has a longer hinge-line.

The two specimens, on which the species is founded, consist of (fig. 12, Pl. II) a cast of a left valve showing the muscle-scars and contour of the shell with a small portion of the shell below; and (fig. 11, Pl. II), a semi-decorticated specimen of both valves which has lost the thin fragile portion of the shell next the posterior superior angle, and therefore at first sight appears to be of different contour from the cast, this being due to an accident in extracting the specimen from the matrix.

*MODIOLA EMACIATA*, *de Koninck*, 1885. Pl. II, fig. 13.

*MODIOLA EMACIATA*, *de Koninck*, 1885. Faune du Calcaire Carbonifère de la Belgique (Ann. Musée R. d’Hist. Nat., tome xi), pt. 5, p. 177, pl. xxviii, fig. 25, description by Prof. Jules Fraipont.

*Specific Characters.*—Shell small, obliquely U-shaped, rhomboidal, very gibbose. The anterior end is small, anterior superior angle prominent, excavated above by

a distinct but small lunule. The anterior border, starting above at the most anterior point of the shell, immediately descends with a regular curve posteriorly, and passes imperceptibly into the inferior border, which is straight and directed obliquely downwards and backwards. The posterior border is obliquely truncate downwards and backwards in its upper half, bluntly rounded below, where it passes with a regular curve into the inferior border.

The hinge-line is slightly arched with convexity upwards, equal in length to one-half the greatest oblique measurement of the shell. The umbones are tumid, anterior but not terminal, pointed and directed forwards, contiguous. The posterior or greater portion of the shell is obliquely swollen, the gibbosity extending downwards and backwards to the posterior inferior angle; above the swelling the shell is compressed and expanded, being quite flat and thin at the posterior superior angle.

*Interior* unknown.

*Exterior*.—The shell is almost smooth above, but very fine striæ are visible, and towards the ventral edge slight shallow folds, which become fine lines at the posterior border above.

*Dimensions*.—Pl. II, fig. 13, measures—

Dorso-ventrally	.	.	.	.	10 mm.
Antero-posteriorly	.	.	.	.	16 mm.
Elevation of single valve about	.	.	.	.	3 mm.

*Locality*.—Carboniferous Limestone of Wensleydale.

*Observations*.—I am, so far, aware of only one specimen of this species from Great Britain, which I have, with hesitation, referred to *M. emaciata* of de Koninck, described by J. Fraipont (*op. supra cit.*). A number of small species of *Modiola* are described by these authors, which are stated to differ from each other in series in a few small details of size and shape. *M. emaciata* is said to resemble *M. impressa*, de Koninck, more than any other, but this shell is “plus longue et moins haute vers l'extrémité postérieure.” Both shells come from Visé, stage 3, and are said to be very rare; and it might turn out, if many specimens were obtained, that they were only varietal forms of the same species.

The shell figured is from the Manchester Museum, Owens College, the authorities of which I have to thank for permission to describe the shell.

MODIOLA LIGONULA, de *Ryckholt*, 1847. Pl. VII, figs. 5, 5 a, 6.

MYTILUS LIGONULA, de *Ryckholt*, 1847. Mém. Couronn. Soc. Royale Belgique, vol. xxiv; Mélanges Paléontologiques, part 1, p. 136, pl. vii, figs. 18, 19.

— FABALIS, de *Ryckholt*. Ibid., p. 137, pl. vii, figs. 20, 21.



- MODIOLA FABALIS, *de Koninck*, 1885. Annales Musée R. Hist. Nat. Belgique, vol. xi, Faune du Calcaire Carbonifère de la Belgique, 5me partie, Lamellibranches, p. 179, pl. xxviii, figs. 10, 11.
- — *Bigsby*, 1878. Thesaurus Devonico-Carboniferus, p. 309.

*Specific Characters*.—Shell oblique, transverse, gibbose, so as to be almost cylindrical, anteriorly expanded and rounded posteriorly. The anterior portion of the shell is almost obsolete, and below the level of the umbones is swollen with bluntly rounded border. The inferior border descends at first backwards and downwards with a gentle curve; it then becomes sinuous, and posteriorly is more convex where it passes with a regular curve into the posterior border, which is expanded and rounded. The hinge-line is straight, and passes insensibly into the posterior border in a gentle curve. There is no indication of an angle. The umbones are tumid, blunt, non-contiguous, and directed forwards, situated very much forwards but not terminal. There is a very small and almost obsolete lunule in front of them. Proceeding downwards and backwards from the umbones the valves are much inflated obliquely, immediately anterior to which is an oblique constriction, becoming broader and deeper as it approaches the margin of the shell. Above the constriction the valves are compressed so as to become hollowed, the posterior superior angle of the shell being expanded.

*Interior*.—No details of the muscle-scars are to be seen on the specimens which have yet been obtained.

*Exterior*.—Certain portions of the left valve of fig. 5, Pl. VII, show the shell to have been ornamented with fine concentric lines of growth, crowded in front.

*Dimensions*.—Fig. 5, Pl. VII, measures—

Antero-posteriorly	.	.	.	.	20 mm.
Dorso-ventrally	.	.	.	.	11 mm.
From side to side	.	.	.	.	10 mm.

*Locality*.—The highest bed of the Calciferous Sandstone series of St. Monans, Fife.

*Observations*.—The specimens figured were obtained by me when I was examining the coast sections of the Calciferous Sandstone beds of Fifeshire. They are quite unlike any other member of the genus *Modiola* described from British Carboniferous beds, and are distinguished by the regularly rounded posterior end and tumid form. From the description and figures I have referred them to *M. ligonula*, a species described by de Ryckholt from “l’argile carbonifère” of Tournay. His description is “médiocrement renflée, même un peu déprimée à l’extrémité anale; . . . côté buccal rétréci et tronqué; côté anal allant en s’élargissant et arrondi en avant; côté palléal un peu bâillant; crochets presque terminaux.” I



think it is very probable that the shell described from the same bed by this author as *Mytilus fabalis* is a slightly smaller specimen of the same species, the description and figures resemble the former very closely. De Koninck only adopts the latter species, which he says is founded on a single valve, a right one; but de Ryckholt figures a left valve, and also gives a view from above of a bivalve example. De Koninck figures a right valve with a very rounded posterior border, which is stated to be "l'échantillon-type décrit par ce paléontologiste" (de Ryckholt). The description of *M. ligonula* coming before that of *M. fabalis* must therefore be adopted, if I am correct in my surmise that the two species are identical.

MODIOLA JENKINSONI, *M'Coy*, 1853. Pl. VIII, figs. 1, 1 *a*, 1 *b*, 2, 3.

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|------------------------|----------------------|---|
| LITHODOMUS JENKINSONI, | <i>M'Coy</i> , 1853. | Ann. Mag. Nat. Hist., ser. 2, vol. xii,<br>p. 189.  |
| —                      | —                    | <i>M'Coy</i> , 1855. Classification Brit. Palæoz. Rocks, p.<br>493, pl. iii, F., fig. 2, 2 <i>a</i> .               |
| —                      | —                    | <i>R. Etheridge</i> , 1885. British Fossils, vol. i, Palæozoic,<br>p. 284.  |
| —                      | —                    | <i>Young and Armstrong</i> , 1871. Carboniferous Fossils,<br>Trans. Geol. Soc. Glasgow, vol. vii,<br>Suppl., p. 52. |

*Specific Characters*.—Shell transversely oblong, somewhat obliquely gibbose, expanded and somewhat compressed posteriorly. The anterior end is very short, extending very slightly in front of the beaks, and it is very narrow from above downwards. Its border is obtusely rounded, passing with gradual curve into the inferior border, which descends slightly and is convex downwards in its anterior and posterior thirds, and straight in the middle third. The posterior border is obtusely and regularly rounded. The upper dorsal margin is nearly straight, gradually rounding into the posterior end. The umbones are small, tumid, much incurved, and twisted forwards, encroached upon in front by a wide, deep, cordate lunule, and are situated in the anterior one-fifth of the shell. The valves are evenly swollen, most so in front and along an undefined line passing from the umbones downwards and backwards, the tumidity becoming gradually less to a point anterior to the junction of the inferior and posterior borders. Shell convex, but somewhat compressed along the inferior border and at the posterior superior angle.

*Interior*.—In casts the hinge-line appears to be simple. The anterior adductor muscle-scar is shallow and round, situated well within the margin of the shell in the deep hollow below the lunule, and extending inwards. The posterior adductor scar is also at some distance from the posterior margin and is large, oval, and shallow, and

near the dorsal margin. The pallial line is entire, remote from the margin, and extends posteriorly for some little distance beyond the posterior adductor scar, its upper limb returning forwards to terminate in the posterior inferior corner of the scar.

*Exterior.*—The shell is very thin, and is ornamented with irregular fine excentric lines of growth oblique to the long axis of the shell, crowded and more conspicuous in front, becoming more widely separated and at the same time less distinct as they pass over the more tumid portion of the shell. Towards the lower margin and behind, these are crossed by very fine radiating striæ. Near the posterior extremity of the valves the markings become almost obsolete. On the surface of casts the markings on the interior of the shell show similar characters.

*Dimensions.*—Fig. 1, Pl. VIII, measures—

Antero-posteriorly	.	.	.	.	43 mm.
Dorso-ventrally	.	.	.	.	20 mm.
Laterally	.	.	.	.	17 mm.

*Localities.*—England: The Limestone of Lowick, Northumberland, and the Middle Limestone of Wensleydale.<sup>1</sup> Scotland: Carluke, in the Lingula Ironstone. Ireland: Carboniferous Limestone of Killogunra, Killala.

*Observations.*—This species was described by M'Coy, under the genus *Lithodomus*, from a fine series of specimens obtained from the Lowick Limestones by the Rev. L. Jenkinson. Having some doubt as to the correctness of this generic reference, I asked Mr. Edgar Smith, of the Conchological Department of the British Museum (Natural History Branch), to look at the specimens. He kindly wrote me as follows: "At first sight I regarded the enclosed as true *Lithodomi*, but a comparison with that genus hardly justifies that opinion. The form is different, and *Lithodomus* does not exhibit regular radiating lines. The subgenus *Botula* has similar prominent umbones, but the general shape of the shell is different. There is a group of *Modiola*, including *M. glaberrima*, D. Kr.; *M. arborescens*, Chemnitz; *M. elegans*, Gray, with which your shells might, I think, be associated." I have therefore referred this species to the genus *Modiola*, but I must confess that I felt very doubtful as to this species belonging to the Family Mytilidæ at all until I was thus reassured by Mr. E. Smith. I know of no specimens of this shell except those in the Woodwardian Museum, Cambridge; and I have to thank the authorities for the loan of a fine series for examination, and also for permission to re-figure the type specimen, Fig. 1, Pl. VIII. The shell is, however, mentioned in the Survey lists as occurring in the Middle Limestone of Wensleydale. This species differs from all other Carboniferous *Modiolas* yet known in shape, the possession of well-marked umbones, with a distinct anterior lunule; the distance of its anterior adductor

<sup>1</sup> 'Geol. Surv. Memoir,' Country round Mallerstang, p. 202.

muscle-scar from the margin, the absence of any byssal sulcus, and the possession of fine radiating striæ.

*Genus* LITHODOMUS, *Cuvier*, 1817.

- MODIOLA (pars), *Phillips*, 1836. *Geol. Yorkshire*, vol. ii, p. 209.  
 — — *Morris*, 1843. *Catal. British Fossils*, p. 91.  
 — — *M'Coy*, 1844. *Synopsis Carb. Foss. Ireland*, p. 74.  
 LITHODOMUS, *M'Coy*, 1844. *Ibid.*, p. 75.  
 MYTILUS, *d'Orbigny*, 1851. *Prodrome Paléontologie*, vol. i, p. 134.  
 Non LITHODOMUS, *M'Coy*, 1855. *Class. Brit. Palæoz. Rocks*, p. 493.  
 MODIOLA, *Wardle*, 1863. *Geology of Leek*, pl. iii, fig. 6, p. 285.  
 LITHOPHAGA, *Meek and Worthen*, 1865. *Proc. Acad. Nat. Sci. Philad.*, p. 245;  
 and 1868, *Geol. Surv. Illinois*, vol. v,  
 p. 539.  
 MODIOLA, *R. Etheridge, jun.*, 1875. *Geol. Mag.*, dec. 2, vol. ii, p. 241.  
 — *de Koninck*, 1885. *Ann. Musée R. Hist. Nat. Belgique*, vol. xi, p. 175.  
 LITHOPHAGA, *Miller*, 1889. *North American Geology and Palæontology*, p. 486.

*Generic Characters*.—Shell equivalve, transversely elongated, subcylindrical, inflated. Anterior extremity rounded; the posterior rostrated or cuneiform. Cardinal border straight, subparallel to the inferior border. Umbones very anterior, not terminal, inconspicuous. Hinge edentulous. Ligament marginal, thin, subinternal; muscle-scars very faint. Shell of two layers; the inner nacreous, the outer tubular.

*Observations*.—From the general shape and the position of the ligament I have thought it well to separate Phillips's *Modiola lingualis* from *Modiola*, and to place it with *Lithodomus dactyloides*, M'Coy, although there is no evidence that either species were rock-borers. Messrs. Meek and Worthen were evidently of the same opinion when they named a shell which they thought might be identical with *M. lingualis*, Phillips, "*Lithophaga*."

Fischer, in his '*Manuel de Conchyliologie*,' gives *Lithophaga* (Bolten, 1798) and *Lithophagus* (Megale von Mühlfeldt, 1811) as synonyms of the *Lithodomus* of Cuvier, which was invented in 1817. Mr. E. Smith, of the British Museum, informs me that the name was only given in a sale catalogue.

The elongate, narrow, subcylindrical character of the shell has a far greater resemblance to recent *Lithodomi* than to *Modiola*. In well-preserved specimens the fine radiating sinuous markings to be seen on the anterior and lower part of the shell of *Lithodomus* are visible in the Carboniferous forms. This is to be seen in fig. 3, Pl. I, and is finely shown in M'Coy's drawing of *L. dactyloides*.

The shell described as *Lithodomus Jenkinsoni* by M'Coy in the '*British*'



Palæozoic Fossils,' p. 493, pl. iii *f*, fig. 2, is evidently not correctly referred to this genus (*vide antea*, p. 72).

LITHODOMUS LINGUALIS, *Phillips*, 1836. Plate I, figs. 3, 4, 4 *a*, 5. Plate II, figs. 1—4.

MODIOLA LINGUALIS, *Phillips*, 1836. Geology Yorkshire, part 2, p. 209, pl. v, fig. 21.

— — — *Morris*, 1843. Catal. British Fossils, p. 91.

— — — *M'Coy*, 1844. Synops. Carbonif. Fossils Ireland, p. 74.

LITHODOMUS DACTYLOIDES, *M'Coy*, 1844. Ibid., p. 75, pl. xi, fig. 41.

MODIOLA LINGUALIS, *Brown*, 1849. Illustrat. Fossil Conchology, p. 173, pl. lxxii, fig. 42.

MYTILUS LINGUALIS, *d'Orbigny*, 1850. Prodrôme Paléontol., vol. i, p. 135.

MODIOLA LINGUALIS, *Wardle*, 1862. Sleight's Ancient History of Leek, pl. iii, fig. 6.

LITHODOMUS DACTYLOIDES, *Huxley and Etheridge*, 1865. Cat. Foss. Pract. Geol., p. 110.

LITHOPHAGA? LINGUALIS, *Meek and Worthen*, 1868. Geol. Survey Illinois, vol. iii, p. 536, pl. xix, figs. 1 and 2.

MODIOLA LITHODOMOIDES (pars), *R. Etheridge, jun.*, 1875. Geolog. Mag., dec. 2, vol. ii, p. 241, pl. viii, fig. 1.

— PRINCEPS, *de Koninck*, 1885. Ann. Musée R. Hist. Nat. Belg., vol. xi, p. 174, pl. xxviii, fig. 3.

— FUSIFORMIS, *de Koninck*, 1885. Ibid., figs. 2, 4—7, 29, and 30.

— LINGUALIS, *R. Etheridge*. Brit. Foss., vol. i, Palæozoic, p. 285.

— LITHODOMOIDES, *R. Etheridge*. Ibid., p. 285.

LITHODOMUS DACTYLOIDES, *R. Etheridge*. Ibid., p. 284.

Non MODIOLA LITHODOMOIDES, *Ward*, 1890. Trans. N. Staff. Inst. Min. and Mech. Engineers, vol. x, p. 130, pl. i, fig. 11.

*Specific Characters.*—Shell very transversely elongated and slightly oblique, cylindrically flattened from side to side in front, but expanded and flattened posteriorly. The anterior extremity is bluntly pointed and narrow, somewhat flattened towards the ventral margin, but convex above. The ventral margin is convex at the anterior and posterior thirds, but slightly concave in the middle third. The posterior margin is formed by two convex lines meeting at an angle at a point a little below the centre, the upper part having a wider and longer sweep than the lower. The hinge-line is straight, and slightly longer than one-half the extreme length of the shell, and passes into the posterior border almost imperceptibly. The umbones are small and inconspicuous, obtuse, non-contiguous, very anterior, but not quite terminal, not well defined from the rest of the shell in front. The valves are regularly swollen in front, the greatest gibbosity being nearer the upper than the lower border. The swelling is slightly oblique and diminishes, but at the same time



expands upwards and downwards, as it passes backwards. Below the swelling in the middle third of the valve there is a broad shallow constriction corresponding with the concavity in the inferior border. The hinge-line of each valve is depressed anteriorly, so that there is a concave surface between the umbones of the opposing valves posteriorly; this widens out to become lost on the posterior slope of the shell. In this way the edge of the valve commences below the umbo and is directed downwards, but by a slow twist on itself it gradually rises and becomes directed upwards posteriorly, where it comes into close apposition with the corresponding portion of the opposite valve.

The left valve appears to have been more convex than the right. The shell is very thin.

The internal character of the hinge is partially shown in a specimen in the York Museum (Pl. II, fig. 2). It appears to be edentulous, and the ligament to be marginal. The anterior adductor scar is small, excavated, marginal, situated just below and in front of the umbones. The posterior adductor scar is almost obsolete, and represented by a broad flattened area equidistant from the posterior superior and inferior borders.

*The Exterior.*—The shell is ornamented with very fine, close-set lines of growth, which are crowded in front, and, following the contour of the margins of the shell, terminate in the hinge-line. As the lines separate in passing backwards, other fine ones appear in between, and towards the ventral margin there are occasionally deeper wrinkles dividing the striæ into bundles; but these are not continued far posteriorly.

*Dimensions.*—The type specimen of Etheridge's *Modiola lithodomoides* (*L. lingualis*), Pl. I, fig. 4, measures—

Antero-posteriorly . . . . .	90 mm.
Dorso-ventrally at termination of hinge-line . . . . .	29 mm.
Lateral elevation of valve . . . . .	11 mm.

*Localities.*—England: Carboniferous Limestone of Park Hill, near Longnor, Narrowdale, Castleton, and Wensleydale. Ireland: St. Dooghlas, co. Dublin; Millicent, co. Cork; and Clonmel. Scotland: Limestone, East Kilbride.

*Observations.*—I have arrived at the conclusion that many shells described under various names by palæontologists really belong to one and the same species, and conform readily to the figures and description given by Phillips for his *Modiola lingualis*. The original is unfortunately lost, but there is a very well-preserved specimen labelled *M. lingualis* in the Gilbertson Collection now in the British Museum (Natural History), which may be taken as fairly typical, for it was from the fossils collected by Mr. Gilbertson that Phillips drew many of his types. The original specimen is said to have come from Castleton, where I have obtained others, which thus forge another link in the chain of identification. The

original description is "remarkably elongate, with a curved oblique convexity from the beaks; lines of growth delicate, forming furrows on the convexity." Unfortunately little can be learned from the figure, which is that of a young example, and is less flattened at the sides anteriorly and more cylindrical than in the adult, the posterior end being less expanded. M'Coy, while referring to the occurrence of *M. lingualis* in Ireland, says "some obscure specimens of this shell have occurred," but gives no figures. He describes and figures a typical adult example of what I consider to be Phillips's shell, under the name *Lithodomus dactyloides*. Unfortunately the original of this figure has disappeared, but there is a specimen in the Griffith Collection in the Museum of Science and Art, Dublin, which bears the name *L. dactyloides*, and this I take to be the adult and nearly full-grown form of *M. lingualis*. This specimen is certainly of the same species as the shells figured Pl. I, figs. 3 and 5, from Irish Carboniferous beds. M'Coy's description is as follows:—"Width three times the greatest length, cylindrical, extremities obtusely rounded; beaks inconspicuous, close to the anterior end. Surface marked by concentric lines of growth, which near the beak are decussated by very fine, oblique, longitudinal striæ." It will be noted that in his figure the decussating striæ are shown over the greater part of the shell.

The specimen from Park Hill, Pl. I, figs. 4, 4 *a*, the original of Mr. R. Etheridge's *Modiola lithodomoides*, I regard as the adult and full-grown shell of Phillips's *M. lingualis*. This specimen is much larger than the shell figured by Phillips, but equally fine specimens also occur at Castleton with examples of the shell in various stages of growth. Most palæontologists have never given sufficient attention to the changes in size and shape due to growth, but have multiplied to a very great extent the number of species without any real excuse for so doing.

Mr. R. Etheridge, jun., gave a very perfect and accurate description of this shell from the specimen which I am able to reproduce by the kindness of Sir A. Geikie, it being in the Museum of the Geological Survey, Jermyn Street. Mr. Etheridge, however, omits to point out the subangulated posterior margin, and I think confounds two different forms under one title. The Scotch specimens from the neighbourhood of Beith, Ayrshire, possessing certain well-marked characters, which in my opinion are of specific value, and the specific name of *lithodomoides* must be retained for this shell. The Scotch shells are more cylindrical, much smaller dorso-ventrally compared with the antero-posterior diameter. The hinge-line is comparatively much longer than in *L. lithodomoides* from English and Irish limestones, always equalling at least two-thirds of the greatest length of the shell in extent; and the elongated hollow trough formed by the depression of the upper edges of the valves is only found in the Scotch forms.

The second figure given by Mr. Etheridge shows the greater length of the



hinge-line, but no specimens which have come into my hands have the dorso-ventral measurement anteriorly equal to that in his fig. 2, unless they have been flattened and expanded by crushing.

In the measurements given Mr. R. Etheridge, jun., uses the term length for dorso-ventral, and width for antero-posterior diameter.

This author refers to *Lithophaga ? lingualis*, of Meek and Worthen (op. cit.), from the Keokuk group of the sub-Carboniferous series of Illinois and Indiana, as apparently resembling his shell very closely. These authors state, "We are by no means satisfied that this is the species described by Phillips, but prefer to refer it provisionally to that species, rather because we have been unable to find any very reliable differences, than from any great confidence in its exact identity." They note that many of their specimens are much larger than the one figured by Phillips. Judging from the figure given, I should think the reference of the American specimens to *L. lingualis* correct.

A very fine series of shells, forty-five in number, named *Modiola fusiformis*, are in the collection made by de Koninck, now in the Musée de l'Histoire Naturelle of Brussels; several of them are figured in his great work (op. cit.). There is a large amount of variation to be noticed in this series, the depth of the posterior end and the comparative extent of the hinge-line differing slightly in many of them. I have little or no doubt that these shells are identical with those named *M. lingualis* and *M. lithodomoides* from British rocks, and have therefore placed *M. fusiformis*, de Koninck, as a synonym of Phillips's species. I have no hesitation also in referring *M. princeps*, de Koninck, to the same species. M. Fraipont, who is responsible for the sections on *Modiola*, says in his remarks on this fine shell, "Cette magnifique espèce s'éloigne de la plupart de ses congénères et surtout de la *M. lithodomoides*, R. Etheridge, par ses proportions et par sa forme générale." The description would do very well for the British shell, with the exception that it is stated "bord ventral droit," notwithstanding that the figure shows a ventral border concave in its middle third. The approach to angulation of the posterior border is neither described nor depicted, but the type specimen shows this character very plainly marked. In fact, *M. princeps* differs from the adult form of *M. lingualis* in no characters of specific value, mere size in a single example being no sufficient indication for the creation of a new species. There are, however, three smaller specimens mounted on the same plaque as the figured specimen, also named *M. princeps*, which are no bigger than the ordinary adult British forms.

The form *M. Cordolianus*, de Ryckholt, approaches very closely to the species under description. It appears that only the type and one other specimen are in the de Koninck Collection. The former is more expanded posteriorly and flatter than in specimens of the same size of *L. lingualis*, but this may be due to the fact

that the shell is a little crushed. The lines of growth are separated at intervals by more deeply cut interruptions. The second specimen on the plaque has not these distinctive characters, but I hesitate for the present to place *M. Cordolianus* as a synonym of *Lithodomus lingualis*.

LITHODOMUS LITHODOMOIDES, *R. Etheridge, jun.*, 1875. Plate I, figs. 6, 6 a, 6 b, 7, 8.

MODIOLA LITHODOMOIDES (pars), *R. Etheridge, jun.*, 1875. Geol. Mag., dec. 2, vol. ii, p. 241, pl. viii, fig. 2.

*Specific Characters.*—Shell transversely elongate, fusiform, almost cylindrical in front, flattened and expanded behind, very slightly oblique. The anterior end is obsolete. The umbones project in front of the rest of the shell, and are only very slightly marked off from the anterior portion of the shell. The anterior border is obtusely rounded and very narrow. The ventral border is convex in front and behind, concave in the middle third. In the middle and posterior thirds, near the ventral border, the shell becomes bent on itself inwards at right angles, so as to present a narrow inferior surface, the extreme edge of each valve being then directed upwards, so that there is a narrow elongated trench, along the bottom of which the valves come in contact. The byssal opening is in the front part of this trench, as in *Modiola* now inhabiting the Firth of Forth. The posterior border is lanceolate, very obliquely truncate above, and obtusely rounded below, joining the ventral border with a very obtuse curve. The hinge-line is straight, equal in length to about two-thirds of the extreme antero-posterior measurement of the shell; for the greater part of its extent depressed below the level of the valves, but elevated above them where it joins the posterior border, into which it passes with a very obtuse angle. The shell is convexly swollen in the anterior two-thirds, especially above; but below it is only slightly compressed into the ventral margin, towards the middle of which the shell becomes broadly compressed, hollowed more especially in the right valve. Behind, the shell is compressed, flattened, and expanded. The umbones are anterior, elevated above the hinge edge, and remote. From the upper edge of each a ridge proceeds directly backwards, between which and the edge of the valve is an elongated concavity, which, commencing narrow, becomes broader by encroaching on the valve, and then gradually approximates to the central line to meet the edge of the valve, where it becomes the highest part of the shell.

*The interior* is unknown.

*Exterior.*—The surface is covered by fine and close striæ and lines of growth. Here and there towards the ventral margin one of the lines becomes accentuated and raised a little above the level of the others.



*Dimensions*.—The specimen, Pl. I, fig. 6, from Beith, in the collection of Mr. James Neilson, of Glasgow, measures—

Antero-posteriorly	.	.	.	83 mm.
Dorso-ventrally at termination of hinge-line	.	.	.	23 mm.
Laterally	.	.	.	20 mm.

	Long.	Dorso-ventrally.	Laterally.
Another specimen measured	98 mm.,	28 mm.,	and 20 mm.
Fig. 7, Pl. I	„ 87 mm.,	21 mm.,	19 mm.

*Localities*.—Carboniferous shale of Lower Limestone of Beith, Ayrshire; Loraburn, Glen Lora, and Lochwinnoch, Renfrewshire, from shale in the Lower Carboniferous Limestone group.

*Observations*.—Originally described, with a specimen from Park Hill, near Longnor, Derbyshire, as *M. lithodomoides* by Mr. R. Etheridge, jun. I have thought it well to separate the Scotch specimens, as they possess certain distinctive characters, such as a comparatively much longer hinge-line, greater gibbosity compared to the dorso-ventral measurement; a deep, elongated hollow in each valve between the edge of the hinge and the umbones and ridge proceeding backwards from them; and they do not possess the typical posterior border of the Park Hill specimen. I have been enabled by the kindness of Messrs. Craig, of Beith, John Smith, of Kilwinning, James Neilson, Dr. John Young, of Glasgow, and Dr. Hunter, of Braidwood, to examine a large number of specimens of these shells; and though there is, as might have been expected, a certain amount of variation of form, yet the general characters and contour are fairly regular. The distribution would appear to be very local, both horizontally and vertically. As far as I can gather, this species is only met with in shale connected with the lowest (Howrat, Auchenskeith, or Beith) Carboniferous Limestone in Ayrshire and Renfrewshire.

This shell is alluded to at page 43 of the Explanation of Sheet 22, 'Mem. Geol. Survey, Scotland,' under the name "*Lithodomus dactyloides*, M'Coy," as was pointed out by Mr. R. Etheridge in the original paper on this shell; a reference which he considered erroneous, from the fact that the radiating lines of that shell described by M'Coy are not present in the species under discussion.

This species possesses one very marked and peculiar character in the elongated hollow depression between the edge of the valves and the umbonal ridge, well shown in fig. 8, Pl. I, and to an extent in fig. 6 *a*, Pl. I, which forms an escutcheon, a character absent in other species of *Lithodomus* and in *Modiola*. It is unfortunate that this shell always seems to occur with the test well preserved, and no indications are to be seen of what conditions obtained within. The ligament appears to have been marginal and inconspicuous.

LITHODOMUS CARBONARIUS, sp. nov. Plate II, fig. 14—19.

*Specific Characters.*—Shell of moderate size, transversely ovate, lanceolate, moderately convex, and somewhat oblique. The anterior end is narrow, very small, with a bluntly rounded terminal border. The inferior border is gently convex in its whole extent, and slightly oblique downwards and backwards. Towards the posterior end it rises again, and forms a blunt curve with the posterior border, the convexity being downwards and backwards; above, the posterior border is obliquely truncate, but becomes rounded below. The hinge-line is straight, equal in length to about from three-quarters to two-thirds of the extreme length of the shell. It joins the posterior border at a very obtuse angle. The umbones are small and inconspicuous, hardly elevated above the hinge-line, very anterior, but not terminal, marked off from the shell in front by a slight groove. The valves are somewhat convexly swollen, more so above, and compressed and slightly expanded upwards posteriorly. There is no ridge or keel.

*Interior.*—The anterior adductor scar is excavated, marginal, and rounded. The posterior has not yet been exposed. The hinge-line is simple, slightly thickened, and edentulous; bevelled at its lower edge for the insertion of an internal ligament.

*Exterior.*—The surface is ornamented with irregular plicæ and lines of growth oblique to the long axis of the shell, and parallel with the borders. Shell thin, covered with a periostracum.

*Dimensions :*

	Antero-posteriorly.	Dorso-ventrally at end of hinge-line.
Pl. II, fig. 16, from Randerstone, measures	25 mm.	9 mm.
Pl. II, fig. 17, from Eskdale „	20 mm.	8 mm.

*Localities.*—Scotland, Limestone No. 5, Randerstone, Fife, Calciferous Sandstone series; Eskdale; “Scorpion-beds,” Lower Carboniferous.

*Observations.*—I know of no described fossil shells to which I can refer the specimens obtained from Randerstone and Eskdale. Fortunately the slab from the former locality has exposed on it two interiors, in which the hinge characters have been observed. This is in the possession of Mr. J. Kirkby, of Leven, who referred the shell to *L. dactyloides*, M'Coy, in his paper “On the Marine Fossils in the Calciferous Sandstone series of Fife.” ‘Q. J. Geol. Soc.’ 1880, p. 578.

The Randerstone shells have lost their outer coating and periostracum, and appear smooth; but the Eskdale specimens have this coating well preserved.

In the majority of the shells from the latter locality both valves are in contact but lying flat open, and united by the ligament on the planes of sedimentary deposit, pointing to the death of the animal prior to the entombment of the shell. Specimens in this condition are found of all sizes, from that of a pin's head to that of the specimen whose measurements are given above.



## PLATE I.

Fig. 1.—*Modiola patula*. A right valve showing the contour of the posterior end. In the Geological Collection of the Belfast Museum. (Page 58.)

Fig. 2.—*Modiola patula*. A left valve from the Limestone of Co. Cork. In the Collection of Mr. J. Wright, of Belfast. (Page 58.)

Fig. 2 *a*.—*Modiola patula*. To show the upper surface of the same shell. (Page 58.)

Fig. 2 *b*.—*Modiola patula*. The contour line of the valve from above downwards. (Page 58.)

Fig. 3.—*Lithodomus lingualis*. A left valve from Co. Cork. In the Collection of Mr. J. Wright. (Page 74.)

Fig. 4.—*Lithodomus lingualis*. A left valve. One of the types of Mr. R. Etheridge's *Modiola lithodomoides*. From the Limestone of Park Hill near Longnor. In the Collection of the Geological Survey, Jermyn Street. (Page 74.)

Fig. 4 *a*.—*Lithodomus lingualis*. Showing the view from above. (Page 74.)

Fig. 5.—*Lithodomus lingualis*. A right valve from the Limestone of St. Dooghlas' Quarry, Co. Dublin. My Collection. (Page 74.)

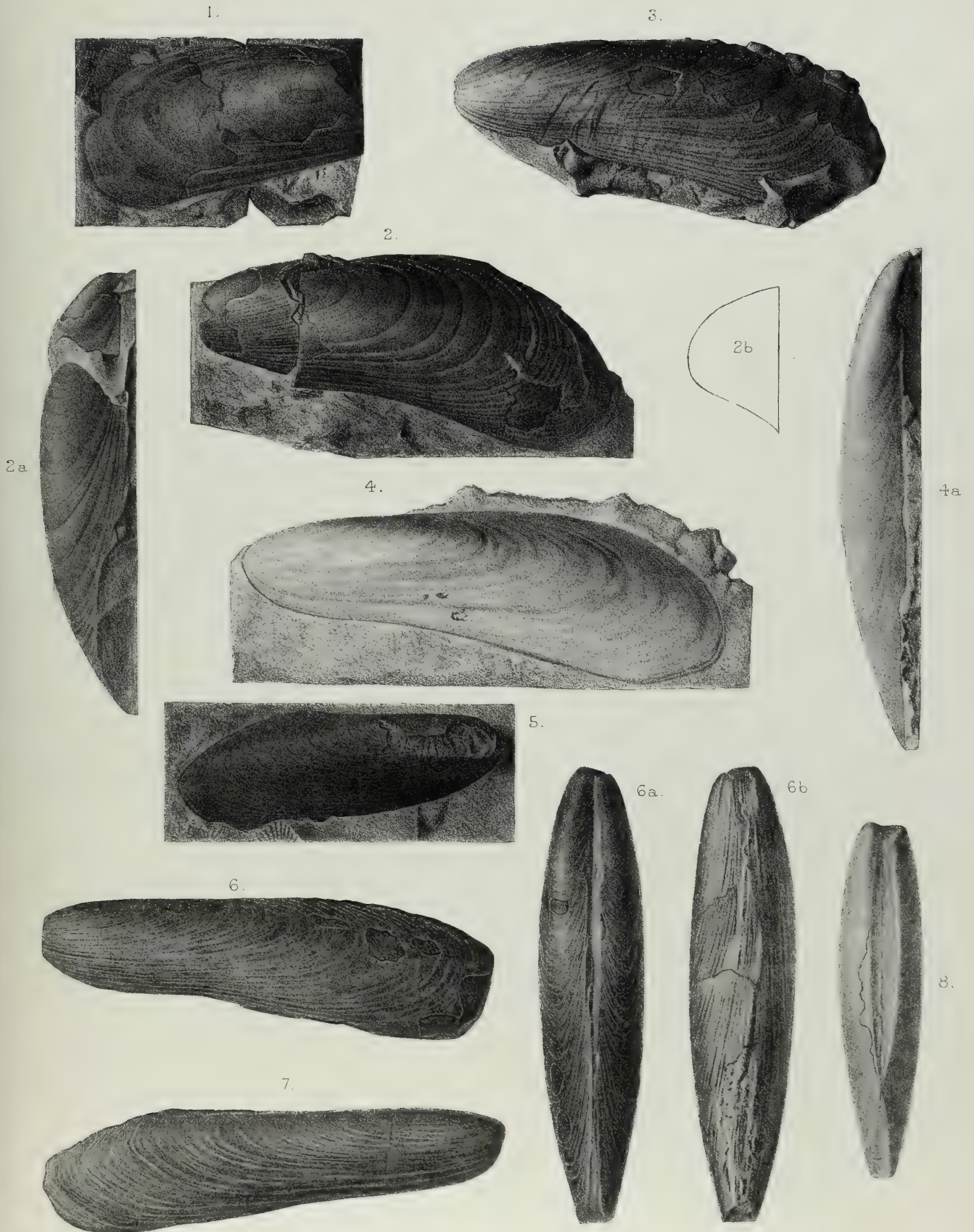
Fig. 6.—*Lithodomus lithodomoides*. A fairly perfect example from the Carboniferous Shales of Beith, Ayrshire. In the Collection of Mr. J. Neilson, Glasgow. (Page 78.)

Figs. 6 *a*, 6 *b*.—*Lithodomus lithodomoides*. Two views of the same specimen one from above and the latter from below. (Page 78.)

Fig. 7.—*Lithodomus lithodomoides*. A more perfect example from the same locality and Collection. (Page 78.)

Fig. 8.—*Lithodomus lithodomoides*. A specimen from the same locality showing the elongated escutcheon, very much developed. Presented to me by Mr. R. Craig, of Beith. (Page 78.)









## PLATE II.

Fig. 1.—*Lithodomus lingualis*. A rare form from the Limestone of Wensleydale. In the Geological Collection of the York Museum. (Page 74.)

Fig. 2.—*Lithodomus lingualis*. A cast showing anterior and posterior adductor muscle-scars from Wensleydale. In the same Collection. (Page 74.)

Fig. 3.—*Lithodomus lingualis*. A medium sized example from East Kelbride. In the Braidwood Collection of Dr. Hunter. (Page 74.)

Fig. 4.—*Lithodomus lingualis*. A perfect specimen. In the Gilbertson Collection, now in the British Museum (Nat. Hist.). (Page 74.)

Fig. 5.—*Modiola megaloba*. A left valve with the test preserved from the Coombes Limestone, Redesdale. Collected by Mr. J. Dunn. (Page 60.)

Fig. 6.—*Modiola megaloba*. Another example from the same locality. (Page 60.)

Fig. 7.—*Modiola megaloba*. A larger example from the same locality, with the test partially preserved, but showing the posterior adductor muscle-scar. (Page 60.)

Fig. 8.—*Modiola megaloba*. A specimen of a left valve, showing portions of the hinge-plate, pallial line, and interior. Same locality. (Page 60.)

Fig. 9.—*Modiola megaloba*. A specimen showing the anterior adductor muscle-scar. (Page 60.)

Fig. 10.—*Modiola megaloba*. A cast of the interior of both valves. The original of Baily's *Myalina Foynesiana*, from Foynes Island, showing pallial line, adductor scars, and the absence of a striated hinge-plate. In the Collection of the Irish Geological Survey. (Page 60.)

Fig. 11.—*Modiola transversa*. An almost perfect example from the Yoredale shales of Congleton Edge. My Collection. (Page 67.)

Fig. 12.—*Modiola transversa*. The cast of a left valve. Showing anterior and posterior adductor muscle-scars. Same locality. My Collection. (Page 67.)

Fig. 13.—*Modiola emaciata*. From the Carboniferous Limestone of Wensleydale, left valve. In the Geological Collection of the Manchester Museum, Owens College. (Page 68.)

Fig. 14.—*Lithodomus carbonarius*. The interior of a left valve, showing the hinge-line from the Calciferous Sandstone series, Randerstone, Fife. In the Collection of Mr. J. Kirkby, of Leven. (Page 80.)

Fig. 15.—*Lithonomus carbonarius*. A partly decorticated example of a right valve on same slab as the preceding. (Page 80.)

Fig. 16.—*Lithodomus carbonarius*. A large example from the same locality. My Collection. (Page 80.)

Fig. 17.—*Lithodomus carbonarius*. Both valves, showing well-preserved test and periostracum. Carboniferous shales of Eskdale. My Collection. (Page 80.)

Fig. 18.—*Lithodomus carbonarius*. Another example from the same locality. My Collection. (Page 80.)

Fig. 19.—*Lithodomus carbonarius*.—From a slab containing very numerous examples, to show the form of young specimens. Same locality. My Collection. (Page 80.)

Fig. 20.—*Modiola Macadamii*. The original of Portlock's *M. Macadamii*, var. *angusta*. From the Collection of the Geological Survey, Jermyn Street. (Page 63.)

Figs. 21 and 22.—*Modiola Macadamii*. Other small examples from the same slab. (Page 63.)

Fig. 23.—*Modiola lata*. The interior of a very poor example from Cultra, Co. Down. My Collection. (Page 65.)

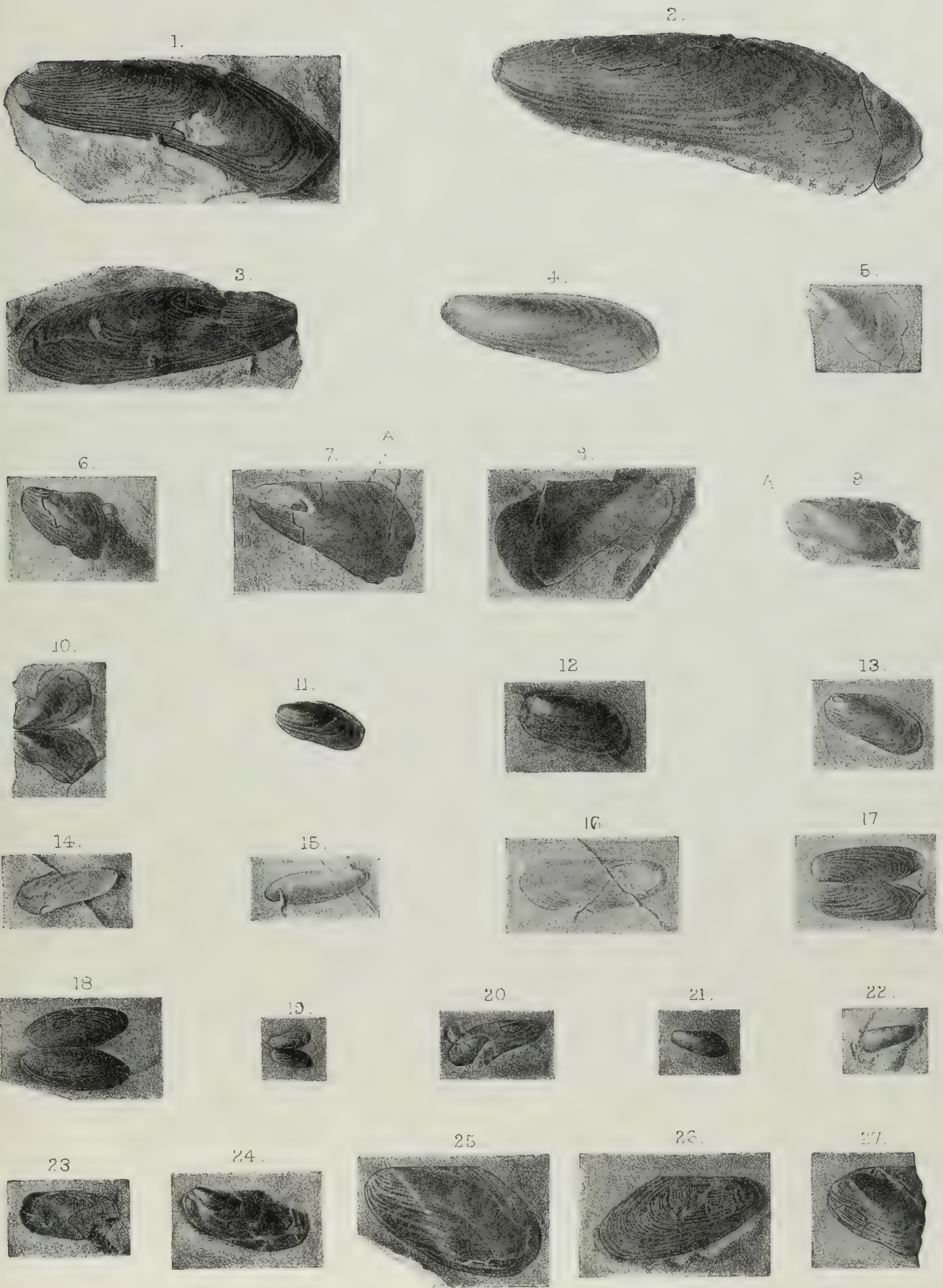
Fig. 24.—*Modiola lata*.—The cast of a left valve showing anterior adductor muscle-scar and an oblique groove passing from the umbo to the lower margin. Portlock's Collection in the Geol. Survey Museum. (Page 65.)

Fig. 25.—*Modiola lata*. The original of *Modiola Macadamii*, var. *lata*, from Ballynascreen, partially decorticated. In the same Collection. (Page 65.)

Fig. 26.—*Modiola lata*. A testiferous example of a left valve. The original of *M. Macadamii*, var. *elongata*. In the same Collection, on the same slab as the preceding. (Page 65.)

Fig. 27.—*Modiola lata*. The anterior portion of the cast of the interior of a left valve showing the anterior adductor scar on the same slab as the preceding. (Page 65.)













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A MONOGRAPH  
OF THE  
**DEVONIAN FAUNA**  
OF THE  
SOUTH OF ENGLAND.

BY  
G. F. WHIDBORNE, M.A., F.G.S.

VOL. III.—PART I.  
THE FAUNA OF THE MARWOOD AND PILTON BEDS  
OF  
NORTH DEVON AND SOMERSET.

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IN the year 1840, Sowerby described twenty-four Devonian species from the beds of the Pilton Series; in 1841 Professor Phillips increased the number to seventy; and in 1852 M'Coy added several species to the list.

Since that time I do not know that many new forms have been described. Professor F. A. Römer in 1855 figured an *Aviculopecten* which appears to have escaped the notice of English geologists; and in 1863 Salter described, without figuring, a species of his new genus *Curtonotus*. Mr. Etheridge, in his list of Devonian Fossils, has catalogued the names of several additional Continental forms.

The present attempt to revise this interesting fauna took its rise in 1890, from a letter of my lamented friend Mr. Thomas Roberts, F.G.S., who drew my attention to the rich collection made by Mr. Townshend Hall, F.G.S., and now in the Barnstaple Athenæum, of which Mr. Roberts prepared, but I do not think published, a list. Soon afterwards I visited Barnstaple by the kind invitation of Mr. Townshend Hall, and began the study of the fauna; and I desire first of all to acknowledge the exceeding kindness with which he and other friends have helped me in an undertaking which has proved much longer and more difficult than I then expected. Nothing could exceed the kindness and courtesy with which the authorities of the British Museum, the Museum of Practical Geology, the Woodwardian Museum, and the Barnstaple Athenæum have permitted me the free use of their fine collections, and in other ways assisted me; and to Dr. Henry Woodward,

F.R.S., Sir Archibald Geikie, F.R.S., Professor T. McKenny Hughes, F.R.S., Mr. J. G. Hamling, F.G.S., and their colleagues my grateful thanks are due. To Mr. Hamling and Miss Partridge, of Barnstaple, I am also under obligations for the loan of specimens from their private collections, and for helping me to collect fossils in the field; my friend Dr. Henry Hicks, F.R.S., has also visited many localities with me, both collecting fossils and making observations, the result of which we propose to give in the sequel. One day, while working in the Barnstaple Athenæum, a gentleman, Mr. Porter, of Pilton, then unknown to me, invited me to see his collection, made through many years; and after showing me his fossils he presented them to me, unsolicited, for the purpose of this work. The generosity of this gift can best be acknowledged by referring the reader to the accompanying plates.

Professor Rupert Jones, F.R.S., Dr. Henry Woodward, F.R.S., Dr. J. W. Gregory, F.G.S., Mr. A. Smith Woodward, F.G.S., Mr. F. A. Bather, F.G.S., Mr. E. T. Newton, F.R.S., Mr. H. A. Allen, F.G.S., Mr. G. C. Crick, F.G.S., and other kind friends have most kindly helped me in guiding me toward the identification of certain of the species; and Mr. W. Rupert Jones, Sub-Librarian of the Geological Society, has shown his usual kindness in helping me to solve perplexing questions of bibliography.

I regret that in the following descriptions<sup>1</sup> so much has often to be left in doubt. Many of the specimens available are casts, many fragmentary, many embedded in matrix, and very many distorted, and sometimes crushed completely out of shape. Probably from such causes errors may in some cases have occurred. It is to be hoped that these may hereafter be corrected through the discovery of more perfect fossils. I can only claim to have done my best to be careful, and to have sought, wherever it was possible, to identify specimens with previously described forms. The present evidence, however, shows that the fauna of these beds is rich and varied, and I believe that we have by no means yet reached the limit of the species that occur in them.

I also regret that some of the localities given are necessarily vague. "Barnstaple" and "Pilton" must be taken as general terms, not indicating a precise spot. Many of the older specimens in museums only bear such general labels. Mr. Porter's fossils were, I understand, for the most part obtained from the immediate neighbourhood of Pilton, but the very richness of the collection prevented me in most cases from learning the exact localities of the various

<sup>1</sup> In the descriptions I have been accustomed to group comparisons with other species under the title of "*Affinities*." It seemed to me a convenient general term, under which points of likeness might be noted without necessarily betokening relationship. As, however, some German authors have criticised me for having sometimes compared species which have only a superficial resemblance, it is as well to observe that I did so *intentionally*, and that I shall continue to do so wherever it may seem advantageous.

specimens. On the other hand, the fossils collected by Mr. Hall, Dr. Hicks, Mr. Hamling, Miss Partridge, and myself bear, as a rule, the accurate name of the place of their occurrence.

It is proposed in the first place to attempt the elucidation of the species, and after that to give the stratigraphical observations made by Dr. Hicks, Mr. Hamling, and myself.

## VERTEBRATA.

FISH REMAINS. Pl. I, figs. 1, 1 *a*.

? 1841. Scales of *HOLOPTYCHUS*, *Phillips*. Pal. Foss., p. 133, pl. lvii, figs. 256 ?  
(Meadfoot), 257 (Baggy).

The only evidence of Vertebrates known to me from the Pilton Beds is a slab containing a few crushed and scattered scales. As far as can be seen, these are wide, flat, oval scales, marked by fine, close, rounded striations, which probably curve parallel to the contour of the margins which are destroyed. The slab was labelled "Fish scales" by the late Mr. Thomas Roberts, F.G.S., and on showing it to Mr. A. Smith Woodward he confirmed this, considering that they are certainly the remains of fish scales, but that, as their shape is quite lost, it is impossible further to decide their character.

*Locality*.—The Strand, Ashford. A single slab is in the Barnstaple Athenæum.

Phillips figures an elliptic scale from Baggy Point, which appears to be similarly ornamented, and may perhaps be identical.

The scales of *Phyllolepis* and *Pentagonolepis*<sup>1</sup> seem to be similarly ornamented.

## ARTHROPODA.

### TRACHEATA.

CLASS—MYRIOPODA, *Latreille*, 1796.

1. *Genus*—CARIDERPESTES, n. gen.

1. CARIDERPESTES GYIUS,<sup>2</sup> n. sp. Pl. I, fig. 2.

*Description of Specimen*.—The only specimen consists of two portions of the body; one extremity and an intermediate portion of the body being lost. The body is very long, sub-cylindrical, slightly diminishing in width as it approaches the tail.

<sup>1</sup> 1888 Lohest, 'Ann. Soc. Géol. Belg.,' vol. xv, p. 159

<sup>2</sup> *Kapís*, a shrimp; *ἐπιήστης*, a crawler; *γυιός*, lame.



The first, which is probably the central portion, contains fifteen narrow somites with straight sides, which are perpendicular to the line of the back, each somite measuring 7 mm. in height by 2 mm. in width. The lower part of the somites appears crossed by a double series of transversely oval concavities, and their front margin seems raised and convexly rounded off at the bottom. To the base of at least every fourth somite remains attached a long narrow appendage or swimmeret (?), which is narrower than the somite, and seems so placed that the front of the somite is in line with the front of its base; it is probable that each somite had a pair of such appendages. These swimmerets (?) show slight signs of segmentation (not visible in the figure), are about 7 mm. in length, slope slightly backwards, and are narrowly lancet-shaped, gradually tapering toward their extremities, where they are rounded off in a blunt point. They are longitudinally bisected by a slight median furrow (ridge in the cast) which traverses them from end to end.

The second portion is less distinct; signs of segmentation occur, but they are apparently oblique to the back, and there are indications of one or two incipient swimmerets (?). Near to the posterior end the body is suddenly constricted by short concavities both above and below, after which it widens out into a caudal prolongation, which seems to consist of some rounded plates, one containing a margined spot, and of a pair of short flapper-like appendages with three segments. The test appears to have been massive, and probably had a granular ornament.

*Size.*—The total length is 57 mm. The lengths of the two remaining fragments are respectively 23 mm. and 22 mm. The width at the front end is 5 mm., close to the tail 3 mm., and across the tail 7 mm. The length of the first swimmeret (?) is 7 mm.

*Locality.*—The only specimen is in the Barnstaple Museum, where it is placed among the Sloly fossils; and the character of the matrix appears to indicate that it came from the Lingula beds of the Sloly group.

*Remarks.*—This fossil is most perplexing and difficult to interpret. Mr. Thomas Roberts, F.G.S., long ago suggested that it might be a spined Myriopod; and, on consulting Dr. Henry Woodward more lately, he made the same suggestion, comparing it with *Euphoberia ferox*, Salter,<sup>1</sup> reviewed by him with other Myriopods in 1887.<sup>2</sup> The difficulties, however, in the way of assigning it to *Euphoberia* are—(1) there are no signs whatever of dorsal spines, the upper line of the body being continuous and simple, and there being no scars on the somites to indicate sub-dorsal spines; (2) there are no clear signs of dorsal plates overlapping two

<sup>1</sup> 1863, Salter, 'Quart. Journ. Geol. Soc.,' vol. xix, p. 86, fig. 8.

<sup>2</sup> 1887, Woodward, 'Geol. Mag.,' dec. 3, vol. iv, p. 1, pl. i, figs. 1—12.

<sup>3</sup> 1881-5, Scudder, in Zittel's 'Palæoz.,' pt. 2, p. 721.



ventral plates; (3) the appendages, appearing only on every fourth segment, are not proved to have existed on all the rest; and seem blade-like and formed for moving in water; and (4) there is considerable evidence of a peculiar extremity.

Scudder<sup>1</sup> certainly figures an example of *Eu. armigera*<sup>2</sup> which appears to have appendages only on every alternate ventral segment, one dorsal segment covering four ventral; but he explains this by supposing the ventral segments to be really only two divided plates. Moreover the genera *Xylobius* and *Archinulus*, though placed in the same sub-order, do not seem to show any signs of spines.

The signs of segmentation in the appendages are obscure, but some of those organs, as figured by Scudder,<sup>3</sup> seem so closely welded that it is quite possible that in the present instance also segmentation really existed. A central longitudinal line, similar to that which is strongly marked in our specimen, is described by Scudder in some species of *Euphoberia*.

In our fossil the lower part of a few of the segments shows marks which, although very indistinct, have probably significance. Within the straight front margin of the plate the surface seems raised in an indented ridge, receding again backwards at the base like the mullion of a window; and behind this are two ovoid concavities, separated above by a horizontal ridge level with the angle of the scallop or indentation.

Professor Rupert Jones points out some resemblance to it in *Anomalocaris Canadensis*, Whiteaves,<sup>4</sup> which he thinks to be allied to *Euphoberia*. Whiteaves's figure shows ten segments, each with two simple appendages, and a caudal extremity with three pairs of irregularly placed equal spines. Our species differs from it, among other points, in having the segments much narrower, and the appendages very much longer.

While, however, there is much reason for regarding this fossil as a Myriopod, it bears some resemblance to the bodies of the *Phyllocaridæ*. The latter appear, as a rule, much shorter, and their segments do not generally have appendages, though in *Nebalia* itself the two last body-somites have tufted appendages.

Lastly, our fossil appears to be a marine organism, both because it probably comes from some bed of the *Lingula squamiformis* series, and because the structure of its appendages seems to show that they may have been natatory organs. While, however, Myriopods are essentially terrestrial, Scudder shows that there is reason to suppose that some at least of the Carboniferous forms were more or less aquatic.

<sup>1</sup> 1882, Scudder, 'Mem. Boston Soc. N. Hist.,' vol. iii, p. 160, pl. xiii, fig. 8.

<sup>2</sup> 1868, Meek and Worthen, 'Geol. Survey Illinois,' vol. iii, p. 556, figs. c, d.

<sup>3</sup> 1882, Scudder, 'Mem. Boston Soc. N. Hist.,' vol. iii, p. 143.

<sup>4</sup> 1892, Whiteaves, 'Canad. Record Science,' vol. v, p. 206, woodcut.

CLASS—CRUSTACEA, *Lamarck*.SUB-CLASS—MALACOSTRACA, *Latreille*, 1806.ORDER—PHYLLOCARIDA, *Packard*, 1879.1. Genus—ECHINOCARIS, *Whitfield*, 1880.<sup>1</sup>1. ECHINOCARIS WHIDBORNEI, *Jones and Woodward*, Pl. I, fig. 3.

1889. ECHINOCARIS WHIDBORNEI, *Jones and Woodward*. Geol. Mag., dec. 3, vol. vi, p. 385, pl. xi, fig. 1.

*Description*.—Carapace bivalved. Each valve subcircular. Dorsal margin straight, about three-quarters the length; front margin slightly curved; ventral and posterior margins much curved. Margins (except the dorsal) bounded by a sharp triangular elevated rim. Surface irregularly convex, divided into three groups of swellings, which are approximately arranged as follows.—A line drawn from the postero-dorsal to the antero-ventral point, and another from nearly the antero-dorsal to the central point, represent furrows or deep concavities dividing the test into three compartments, which we may call the dorsal, the anterior, and the posterior compartments. The dorsal compartment is again divided by shallower grooves into a long narrow hinder swelling, a broad central, and a minute anterior swelling. The anterior compartment is indistinctly divided into a small anterior swelling occupying the extreme antero-superior corner of the test, a large diffuse pyriform swelling, and a minute hinder swelling occupying the posterior angle of the compartment. The posterior compartment has one large diffuse swelling filling it entirely, except its anterior part, which contains a narrow fusiform swelling or promontory starting from the centre, and corresponding to the rear swelling of the dorsal compartment. These swellings are each, except the posterior, ornamented by one or more scattered sharp little tubercles. Two slightly curved longitudinal ridges divide the posterior compartment into three nearly equal petaloid areas, which are transversely slightly concave. These ridges and the rim (at least in the posterior dorsal region) bear a single regular row of similar sharp tubercles.

*Size*.—Left valve 9·2 mm. long by 7·4 mm. high.

*Locality*.—A single specimen, found by Mr. Dufton in a quarry near Sloly, close to the third milestone on the Barnstaple and Ilfracombe Road in the shales of the

<sup>1</sup> 1888. Hall and Clarke, 'Pal. N. Y.', vol. vii, pp. 168—181, pls. xxviii—xxx.

*Lingula squamiformis* beds of the Marwood series, is in the Woodwardian Museum, and a fragmentary specimen from Pilton is in the Porter Collection.

*Remarks.*—This fossil has been very fully described and illustrated by my friends Professor Rupert Jones and Dr. H. Woodward in the 'Geological Magazine,' and the reader is referred to that article for further information upon it.

*Affinities.*—Professor Rupert Jones describes it as larger and less ovate than *E. socialis*, Beecher,<sup>1</sup> and as differing from the other species described by Whitfield, by Clarke, and by Hall, in having two (instead of one) tuberculate ridges.

## 2. Genus—CERATIOCARIS, Salter, 1849.

### 1. CERATIOCARIS? SUB-QUADRATA, n. sp. Pl. 1, figs. 5, 5 a.

*Description.*—Carapace-valve ovate-oblong, gently convex. Dorsal and ventral margins gently arching. Anterior margin broad, truncated, with an ogee contour, rounded at the extremities. Posterior margin broad, elliptical. Ventral margin with a strong double rim, vanishing at its extremities. Surface, as seen from the mould, with a few very minute threads or lines arching from the ventral margin over the shell, with the antero-superior corner as a focus.

*Size.*—Length 19 mm., height 13 mm.

*Locality.*—Two or three specimens on one slab are in my collection from East Anstey station.

*Remarks.*—These fossils are in poor preservation, and it is difficult to discern their true nature. It is my strong impression that they are crustacean, and will probably prove to belong either to *Saccocaris* or a kindred genus. The ornament is not unlike that of a Lamellibranch, but several points seem decisive against such an explanation, while somewhat similar markings are seen in *Estheria*.

Though the ogee shape of the one end agrees with one end of *Ceratiocaris*, the valve appears shorter and more truncate than usual; while the threads on the surface take a different direction from the characteristic longitudinal lineation of that group, with which for the present I have provisionally left it.

*Affinities.*—In general outline it somewhat approaches *C. stygia*, Salter<sup>2</sup>; while *C. inornata*, M'Coy,<sup>3</sup> though longer and more angular has several points of

<sup>1</sup> 1888, Hall, 'Pal. N. Y.,' vol. vii, p. 174, pl. xxx, figs. 1—12.

<sup>2</sup> 1888, Jones and Woodward, 'Mon. Brit. Pal. Phyllop.,' p. 38, pl. x, figs. 7 a, b; pl. xi, figs. 1 3, and 7; pl. xii, figs. 2 a, b.

<sup>3</sup> Ibid., p. 48, pl. x, figs. 2, 3, 5.



resemblance. *Saccocaris major*, Salter,<sup>1</sup> is more similar in its general shape, and has signs of concentric lines though differently arranged.

*Orthonotella Faberi*, S. A. Miller,<sup>2</sup> has a strikingly similar appearance, but is much smaller and narrower, and has more numerous striæ, and straighter and more parallel upper and lower margins. This fossil Professor Rupert Jones noted in 1883 as being probably a phyllocarid.

## 2. CERATIOCARIS ? sp. Pl. I, fig. 6 [cf. Pl. II, fig. 12].

*Description*.—Shape flatly convex, elongate, nearly regularly oval in outline.

*Size*.—Length 5 mm., height 2 mm.

*Locality*.—Two moulds, giving the two sides of one animal, from south-west of Sloly, are in the Woodwardian Museum.

*Remarks*.—These fossils are exceedingly indistinct, being a double mould so divided that the edges are obscure. Almost the only marks I can observe are a slight sharp notch or dent in the centre of one end, and slight indications of a border on the lower margin, apparently becoming a broad, flat, angular rim at one end. The test was perhaps rather thick. It appears to me that it is in all probability the remains of a crustacean, and what can be seen of it is so strikingly like *Ceratiocaris ? simplex*, Clarke,<sup>3</sup> except in size, that it seems best to treat it provisionally as probably akin to that fossil.

*Note*.—Two somewhat similar convex and elegantly oval casts, differing from each other in contour and size, have a neat rim on the free margins. One of these, Pl. II, fig. 12, which is in Mr. Hamling's Collection from Croyde has about the same dimensions as Pl. I, fig. 6, and its surface apparently has a few indistinct microscopical longitudinal ridges.

It resembles *Cytheropsis ? melonica*, Barrande,<sup>4</sup> another very indistinct species, which is somewhat undulated in its dorsal contour. The genus "*Cytheropsis*" has been abandoned.

The other specimen, which is in my Collection from Saunton Point, is about ten times as large.

<sup>1</sup> 1893, Jones and Woodward, 'Mon. Brit. Pal. Phyllop.', p. 84, pl. xiv, fig. 6.

<sup>2</sup> 1882, S. A. Miller, 'Journ. Cincin. Soc. Nat. Hist.', vol. v, p. 117, pl. v, figs. 7, 7b.

<sup>3</sup> 1888, Hall, 'Pal. N. Y.', vol. vii, p. 165, pl. xxxi, fig. 2.

<sup>4</sup> 1872, Barrande, 'Syst. Sil. Bohém.', vol. i, Suppt., p. 509, pl. xxv, figs. 7, 8, Ét. D.



ORDER—CIRRIPIEDIA, *Burmeister*, 1843 (?).

1. Genus—ANATIFOPSIS, *Barrande*, 1872.

1. ANATIFOPSIS ? ANGLICA, n. sp. Pl. I, fig. 4.

*Description*.—Form elongate, subcylindrical, flatly convex. Upper margin bluntly elbowed at about one-fourth its length from the proximal end. Lower margin straight, inclined at a small angle to the upper margin. Proximal end concave, bounded by a narrow-margined rim. Distal end defective.

*Size*.—Length 24 mm., breadth 7 mm.

*Locality*.—There is a single specimen from Sloly in the Porter Collection.

*Remarks*.—This fossil shows no definite structure, the markings generally being too much like those on the adjoining matrix to be relied on. Its shape is peculiar, and may be described as resembling the breech portion of a gun. It sufficiently resembles the fossil named *Anatifopsis acuta* by Barrande<sup>1</sup> to be regarded as possibly congeneric, differing from it in being much more elongate, and not showing the arching distal end seen in the Bohemian species, which Barrande considered as akin to *Lepas*. Two obscure spots, however, occur on the convex surface of our specimen, one of which seems pectiniform. In Dr. Woodward's opinion this pectination may indicate the remains of gastric teeth, and therefore imply that it is a Phyllocarid.

*Affinities*.—*A. longa*, Barrande,<sup>2</sup> which approaches it in length, has a straight upper margin.

<sup>1</sup> 1872, Barrande, 'Syst. Sil. Bohém.,' vol. i, Suppt., p. 579, pl. xxvi, fig. 35, Ét. D.

<sup>2</sup> Ibid., p. 579, pl. xxvi, figs. 42—45, Ét. D.

## CLASS—CRUSTACEA.

## SUB-CLASS—ENTOMOSTRACA, Müller, 1785.

## ORDER—TRILOBITA, MacLeay, 1839.

I. *Family*—PHACOPIDÆ, Salter, 1864.1. *Genus*—PHACOPS, Emmerich, 1839 (emended, 1845).

## 1. PHACOPS LATIFRONS, Bronn, sp. Pl. I, figs. 7—10, and Pl. II, figs. 1—4.

1844.	PHACOPS LATIFRONS,	Ferd. Römer.	Rhein. Uebergangsgeb., p. 81.
1864.	—	—	Salter. Mon. Brit. Tril., p. 18, pl. i, figs. 9—16.
1869.	—	—	Verneuil. Append. Faun. Dev. Bosph., p. 16.
1872.	—	—	Kayser. Zeitsch. Deutsch. Geol. Gesell., vol. xxiv, p. 661.
? 1885.	—	—	Maurer. Abhandl. Grossh. Hessisch. Geol. Landes., vol. i, pt. 2, p. 262, pl. xi, figs. 27—30.
1889.	—	—	Whidborne. Mon. Dev. Fauna, vol. i, p. 6, pl. i, figs. 8, 9.

*Size.*—The largest English specimen which I have seen (locality unknown), exceeds five inches in length.

*Localities.*—The specimens are almost always either detached heads, bodies, or pygidia. In the Museum of Practical Geology are four from Croyde, one from East Hill, Braunton, three (including a head figured by Salter) from New Road Quarry, Pilton, and one from Baggy Point. In the Barnstaple Athenæum are 2 from Saunton, 3 from Pilton, 10 from Top Orchard, 1 from Bradiford, 1 from Brushford, 5 from Kingdon's, Shirwell, and 1 from Roborough. In the Porter Collection are 4 from Pilton, 1 from Top Orchard, and 1 from Poleshill. In the Woodwardian Museum are 16 from Top Orchard, 1 from west of Saunton Court, 1 from south-west of Sloly, and 60 from Barnstaple. In the British Museum are four from Marwood and Barnstaple.

*Remarks.*—As the specimens of this well-known Trilobite from these beds, though so numerous, are all imperfect, and generally distorted, I have for the present deferred attempting a detailed description of them, especially as the species has already been fully described by Salter in his Memoir published by the Palæontographical Society.

It appears to me that all the above-named specimens most probably belong to the present species, though they vary very greatly in size, and have in some cases

been referred to *Phacops granulatus*, or *Trimeroccephalus lævis*. Some of the specimens in the Woodwardian Museum are at first sight very different, being apparently shorter with narrower segments and a narrower axis, but my impression is that these differences are entirely due to distortion. Even the very small heads appear to have the usual obtuse and perpendicular front margin characteristic of this species, and not the subangular and protruding fronts seen in *T. granulatus* from South Petherwyn.

Again, as a specimen in the Museum of Practical Geology labelled *T. lævis*, Münster, sp., from Brushford, which was probably the grounds for Salter's recording that species from these beds, appears to be exactly similar to our other specimens, I am inclined to delete that species from the Pilton list.

The coarse granulation, absence of furrows, and great width and shortness of the glabella, and especially its unprotruded perpendicular front, seem to be some of the distinguishing marks of the species. The axis of the pygidium shows tubercles in well-preserved specimens.

*Affinities*.—*P. Potieri*, Bayle,<sup>1</sup> seems to have a narrower, more protruding, and more finely granulated glabella.

*P. rana*, Green,<sup>2</sup> has finer tubercles on the glabella and more segments in the pygidium.

*P. altaicus*, Tschernyschew,<sup>3</sup> has a longer glabella, with a more convex and protruding front, and more segments in the pygidium.

## II. *Family*—PROËTIDÆ, *Barrande*, 1852.

### 1. *Genus*—PHILLIPSIA, *Portlock*, 1843.

#### 1. PHILLIPSIA HICKSII, n. sp. Pl. II, figs. 5—8.

*Description*.—General form very elongate, ovate; in section deep. Thorax relatively large, the proportionate length of head, thorax, and tail being about 5 mm., 8 mm., and 5 mm.

Head-shield small, nearly semicircular. Glabella large, subcylindrical (*i. e.* considerably elevated, with straight sides and rounded anteriorly), reaching to the

<sup>1</sup> 1878, Bayle, 'Explic. Carte Géol. France, Atlas,' pl. iv, figs. 7—10; and 1889, Kayser, 'Abhandl. Kön. Preuss. Geol. Landes.,' n. s., pt. 1, p. 67, pl. x, figs. 5, 6; and pl. xxiii, figs. 1—6.

<sup>2</sup> 1832, Green, 'Mon. Trilob. N. Amer.,' p. 42; and 1888, Hall, 'Pal. N. Y.,' vol. vii, p. 19, pl. vii, figs. 1—11; pl. viii, figs. 1—18; and pl. viii A, figs. 21—33.

<sup>3</sup> 1893, Tschernyschew, 'Verhandl. Russ. Kais. Miner. Gesell.,' vol. xxx, p. 4, pl. i, figs. 1—5.



rim in front. Basal lobes rather large, subtriangular. Glabella-furrows three (including that which bounds the basal lobe), short, sufficiently clear except the first. Neck-furrow deep. Neck-lobe arching, rather broad. Rim (in front of glabella) rather broad, sigmoid in section. Fixed cheeks exceedingly narrow in front, medianly convex at the eyes. Surface bearing numerous small scattered tubercles. Free cheeks large, gently convex, subtriangular. Genal angles acute, apparently prolonged into short spines. Eyes of medium size, elongate, bean-shaped, rather elevated, situated centrally on the cheeks close to the glabella.

Thorax large, of nine rather broad segments. Axis wide, elevated, semi-cylindrical, bounded by deep axial furrows. Segments divided by a distinct central groove on the limbs.

Pygidium small, probably slightly broader than long, highly ornate, composed of thirteen coalesced somites. Axis deeply convex, slightly flattened above, nearly one-third the width of the pygidium at the proximal end, but diminishing regularly and rapidly, and terminating bluntly at a quarter the length of the pygidium from the posterior margin, followed by an indistinct prolongation. Rings of axis thirteen (of which eleven are distinct), narrow, elevated, each bearing a row of about ten strong sharp tubercles. Limb with eight grooved pleuræ, each of which consists of a narrow raised rib, irregularly tubercled, extending to, and apparently becoming wider at, the border, and of a lower and shorter intermediate rib, similarly ornamented, and placed immediately behind the major rib in the furrow. Border convex, broad, rather distinctly defined by a linear depression, one-fifth the length of the tail behind, and becoming slightly narrower laterally, the tuberculated ribs being visible across it.

*Size.*—A specimen measures 18 mm. long by 8 mm. wide across the first, and 7 mm. wide across the last thoracic segment. A distorted glabella is 6 mm. long by 3 mm. wide. A distorted pygidium is 7 mm. long by 11 mm. wide.

*Localities.*—In the Barnstaple Athenæum is a complete but very much decayed specimen from the shore near Fremington, and two beautifully preserved pygidia labelled Pilton and Braunton Road; and in the Porter Collection two pygidia and a glabella from Pottington. All these specimens appear to have been collected by Mr. Porter, and therefore probably all, except the first, may have come from one locality.

*Remarks.*—The complete specimen, occurring in light brown sandstone and much decayed, is crushed obliquely, which perhaps gives it the appearance of being more elongate than that it actually is, but even so it appears to be distinguishable by the large relative size of the thorax and by its elongate form. It serves the purpose of showing that the more perfectly preserved specimens of detached pygidia and glabella belong to one species.

The other specimens are in a much squeezed and twisted blue limestone; and,



though in a beautiful state of preservation, are so distorted that their exact shape and relative dimensions cannot be ascertained. The pygidia assume, in fact, such different appearances, according to their lie in the stone, as to suggest at first sight that they are specifically distinct; but Dr. Hicks, who has examined them, confirms my opinion that they all undoubtedly belong to a single species.

*Affinities.*—The present species evidently belongs to the genus *Phillipsia*, and approximates *Ph. truncatula*, Phillips,<sup>1</sup> sp., but differs distinctly in the shape of the glabella, the number of glabella-furrows, the number of somites in the pygidium, and in the presence of a distinct broad elevated convex border round both head and tail.

*Ph. gemmulifera*, Phillips, sp.,<sup>2</sup> differs in being broader, and in having a shorter thorax and a smooth glabella, and narrower fixed cheeks.

It may be observed that the ribs of the pygidium seem more definitely distinct and divided than is usual in *Phillipsia* or *Griffithsides*, thus approaching those of *Brachymetopus*. From *B. uralica*, de Verneuil,<sup>3</sup> which it simulates in that respect, it differs in its broader and more developed border, and in its rings being only twelve or thirteen instead of seventeen, while its head is of course totally unlike.

## 2. Genus—BRACHYMETOPUS, M'Coy, 1847.

This genus is distinguished from its neighbours by the small size and triangular form of the glabella, *Dechenella* approaching it most nearly in these respects, but differing as well in the greater size of the glabella and its more defined lobes as in the strong striated margin of the pygidium. Several species have been described by M'Coy, H. Woodward, and others from the Carboniferous beds. The following species carries back the genus to the Devonian; while, as Ehlert<sup>4</sup> points out, *Proëtus micropygus*, Corda,<sup>5</sup> represents it in the so-called Silurian Étages E and F of Bohemia.

<sup>1</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 240, pl. xxii, figs. 12, 13; and 1883, H. Woodward, 'Mon. Carb. Trilobites,' pt. 1, p. 21, pl. iii, figs. 9—14.

<sup>2</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 240, pl. xxii, fig. 11; and 1883, H. Woodward, 'Mon. Carb. Trilob.,' pt. 1, p. 17, pl. iii, figs. 1—8.

<sup>3</sup> 1845, de Verneuil, 'Geol. Russ.,' vol. ii, p. 378, pl. xxvii, figs. 16 *a*, *b*; and 1884, H. Woodward, 'Mon. Carb. Trilob.,' pt. 2, p. 48, pl. viii, figs. 1—8.

<sup>4</sup> 1885, Ehlert, 'Bull. Soc. Étud. Sci. Angers,' Ann. 1885, p. (9), pl. i, figs. 1, 2, cf. with 4.

<sup>5</sup> 1852, Barrande, 'Syst. Sil. Bohém.,' vol. i, p. 445, pl. xv figs. 37—39.

1. *BRACHYMETOPUS WOODWARDII*, n. sp. Pl. II, figs. 9—11.

*Description*.—Head-shield minute, semicircular, surrounded by a broad flat border. Glabella very elevated, about two-thirds the length of the head, and about twice as long as broad. Cheeks elevated. Eyes small, lunate, situated in the centre of the cheeks. Surface tuberculate.

Pygidium very convex, semicircular. Axis nearly as wide as limb, very elevated, bluntly truncated below, and with eleven or twelve lofty narrow rings, which bear numerous tubercles, of which the central vertical row seems the largest. Limb with seven elevated ribs on each side. Ribs simple, bearing a few coarse tubercles, and extending to the border, which they appear to nodulate, a single corresponding nodule being at the posterior point of the border.

*Size*.—Head-shield about 3·50 mm. long by 5 mm. wide. A pygidium measures 2 mm. long, 4 mm. wide, 1·25 mm. deep.

*Localities*.—Two specimens, a head-shield and a pygidium, are in the Porter Collection from Pottington. A head-shield from the lane between Wrafton and Heanton is in my collection.

*Remarks*.—We have in this case a head-shield and a pygidium of the identity of which there is no direct evidence, but which occur in the same beds, are totally unlike any accompanying species, and have such a general congruity that it appears to be practically safe to assume that they belong to each other (specifically). In this view Dr. H. Woodward agrees, and he confirms me in regarding it as a species of *Brachymetopus* allied to *B. MacCoyi*, from which it differs in the larger size of its glabella, and the fewer somites, greater shortness, broader axis, and more highly ornamented character of its pygidium.

The specimen of the pygidium being in the nature of an internal cast, it is not clear whether the final spines or tubercles of the lateral ribs extend beyond the border, and so break the contour of the margin, but they certainly give indications of doing so; and such a feature is hinted at by M'Coy<sup>1</sup> in his description of the genus.

ORDER—OSTRACODA, *Latreille*, 1801.

In the examination of the little fossils of this group I have had the advantage of the guidance and assistance of my kind friend Professor Rupert Jones. They have for the most part been the result of very recent discoveries, and probably by

<sup>1</sup> 1847, M'Coy, 'Ann. Mag. N. Hist.,' ser. 1, vol. xx, p. 230.

no means cover the whole ostracodal fauna of the beds. Time did not permit their full study before they were put on the plate, and consequently they were then arranged according to their apparent general similarity. A more minute examination proved that in some cases these resemblances were deceptive, and were due simply to the crushing or corrosion of specimens having really different characters. While this has caused some of the figures to be useless as far as the elucidation of their own species is concerned, it is perhaps not uninteresting as showing how easily one genus may apparently be transformed into another by a slight modification of its characters.

I. *Family*—LEPERDITHIDÆ, Jones, 1868.

1. *Genus*—ISOCHILINA, Jones, 1858 (and 1870).

1. ISOCHILINA CANALICULATA, Krause. Pl. II, figs. 13—15; and Pl. III, figs. 1—2 *b*.

1892. ISOCHILINA CANALICULATA, Krause. Zeitsch. Deutsch. Geol. Gesell.,  
vol. xlv, p. 385, pl. xxi, figs.  
1 *a*, *b*.

*Description*.—Valve suboblong, generally rather short, moderately convex, with a central spot or muscle-mark. Dorsal margin rather shorter than the valve. Free margins bounded by a definite rim.

*Size*.—Length 2 mm.

*Localities*.—In the Porter Collection is a slab with several specimens, from Poles Hill; and in my collection two specimens from Upcott Arch Quarry, and one from Saunton Hotel.

*Remarks*.—These specimens all appear to be casts; they seem always to show the central spot or dent.

Professor Rupert Jones has identified the more perfect specimens with Krause's species. He considers they come very near to *Primitia valida*,<sup>1</sup> but are distinguished by the ventrally protruding convexity of the valves, and by the outstanding lips or borders.

From *P. centralis*, Ulrich,<sup>2</sup> they seem to differ chiefly by being more convex.

*Primitia cestrensis*, var. *caldwallensis*, Ulrich,<sup>3</sup> and *P. subæquata*, Ulrich,<sup>4</sup> are also so similar as hardly to be distinguishable except in the same particulars.

<sup>1</sup> 1886, Jones and Holl, 'Ann. Mag. N. H.,' ser. 5, vol. xvii, p. 409, pl. xiv, figs. 7—9.

<sup>2</sup> 1890, Ulrich, 'Journ. Cincin. Soc. N. H.,' vol. xiii, p. 130, pl. x, figs. 1—3; and 1893, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlix, p. 291, pl. xii, fig. 1.

<sup>3</sup> 1891, Ulrich, 'Journ. Cincin. Soc. Nat. Hist.,' vol. xiii, p. 201, pl. xiv, figs. 7 *a*—*c*.

<sup>4</sup> Ibid., p. 202, pl. xiv, figs. 8 *a*—*c*.



## 2. Genus.—APARCHITES, Jones, 1889.

### 1. APARCHITES LINDSTRÆMI, Jones, var. EXCELLENS, nov. var. Pl. III, fig. 3, 3 a.

1889. APARCHITES LINDSTRÆMI, Jones. Ann. Mag. N. H., ser. 6, vol. iv, p. 272, pl. xv, figs. 14 a, b.

*Description*.—Valve short, ovate, convex. Anterior end subtruncate, rather narrower than the other, which is rounded. Dorsal edge rather short. Ventral margin strongly arched. Surface bearing a small, low tubercle close to the antero-dorsal corner.

*Size*.—Length 2 mm., height 1·5 mm.

*Locality*.—A specimen from Kingdon's, Shirwell, is in the Barnstaple Athenæum.

*Remarks*.—The figured specimen is embedded in hard limestone, and possibly does not show the true margin all round. Professor Rupert Jones considers it to approach very near to *A. ovatus*, Jones and Holl, sp.<sup>1</sup> It differs, however, from it in being shorter and more evenly convex. *A. simplex*, Jones,<sup>2</sup> agrees better in these points, but seems more regularly oblong. *A. Lindstræmi*, Jones,<sup>3</sup> is almost identical in outline, but is so much smaller and flatter as probably to indicate that our specimen belongs rather to a larger variety than to the described type.

## 3. Genus.—PRIMITIA, Jones and Holl, 1865.

### 1. PRIMITIA SPARSINODOSA, n. sp. Pl. III, figs. 4—6.

*Description*.—Valve elongate, oval, convex. Dorsal and ventral borders almost straight. End borders rounded. Valve divided by a deep, broad dorsal furrow, sloping down from the centre forward, and separating it into two flatly swollen convexities, each of which bears a tubercle (not distinctly shown in the figure) near the centre of its lateral face, while another small tubercle is on the angle of the anterior lobe, overhanging the furrow.

*Size*.—Length ·83 mm.

*Locality*.—Three specimens are on the slab in Miss Partridge's collection from Saunton Hotel.

<sup>1</sup> 1865, Jones and Holl, 'Ann. Mag. N. H.,' ser. 3, vol. xvi, p. 10, pl. xiii, figs. 13 a—c; and 1891, Krause, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xliii, p. 492, pl. xxix, figs. 9 a—c.

<sup>2</sup> 1889, Jones, 'Ann. Mag. N. H.,' ser. 6, vol. iv, p. 272, pl. xv, figs. 13 a—c; and 1891, Krause, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xliii, p. 491, pl. xxix, figs. 8 a—c.

<sup>3</sup> 1889, Jones, 'Ann. Mag. N. H.,' ser. vi, vol. iv, p. 272, pl. xv, figs. 14 a, b.



*Remarks.*—These specimens are casts, but show the shape rather clearly; they evidently had rather thick tests.

Professor Rupert Jones was inclined to identify these specimens with his *Primitia mundula*, var. *longa*.<sup>1</sup> Our specimens, however, on close examination show several distinct scattered tubercles, which do not seem to exist in *P. mundula*; and, moreover, the sulcus sets forward instead of being nearly vertical, and the shape is more oval.

*Bollia? sinuata*, Krause,<sup>2</sup> seems more oval, and the central furrow is more direct, and ends in a circular pit.

*Primitia impressa*, Ulrich,<sup>3</sup> is relatively shorter and more oval.

*Ulrichia confluens*, Ulrich,<sup>4</sup> is somewhat similarly nodulated, but its furrow is much wider and more L-shaped.

The small specimen, fig. 4, appears probably to be a young or indistinctly preserved example of the same form.

## 2. PRIMITIA, sp. Plate III, figs. 7—11.

*Description.*—Valve elongate, ovate-oblong. Dorsal and ventral edges nearly straight. Ends nearly evenly convex. Surface finely tuberculate, marked with a slight central inequality in the dorsal region.

*Size.*—Length 1 mm.

*Locality.*—Two specimens from Pilton are in the Porter Collection; two from Saunton Hotel in Miss Partridge's Collection; and several, which are very doubtful, from Saunton Hotel in my Collection.

*Remarks.*—These fossils show very little character; there are indications of a central vertical inequality in the valve, which is probably Primitian in character, but has been more or less modified by pressure. The four first-mentioned specimens appear to have been covered with a very fine granulation. In those from Saunton the great squeezing of the beds has very much obscured the natural shape, as will be seen from my two specimens figured from that locality.

<sup>1</sup> 1893, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlix, p. 291, pl. xii, figs. 4 *a*, *b*.

<sup>2</sup> 1891, Krause, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xliii, p. 498, pl. xxxi, fig. 2.

<sup>3</sup> 1890, Ulrich, 'Journ. Cincin. Soc. N. H.,' vol. xiii, p. 131, pl. x, figs. 3, 4.

<sup>4</sup> 1891, Ulrich, *ibid.*, vol. xiii, p. 203, pl. xii, figs. 11 *a*, *b*.

3. *PRIMITIA* ? sp. Plate III, fig. 12.

*Description*.—Valve very small, evenly convex, short, subovate. Dorsal border straight, rather short. Anterior border narrow, bluntly subangular. Posterior border semicircular, broad. Ventral border convex.

*Size*.—Length .5 mm.

*Locality*.—One indistinct specimen is in a slab with other Ostracods in Miss Partridge's Collection from Saunton Hotel.

*Remarks*.—This indistinct little fossil seems in general shape extremely like *Leperditia* ? *seneca*, Hall, as given by Jones,<sup>1</sup> but it appears to show a slight sulcus in the dorsal centre followed by a slight posterior elevation, and therefore is probably a species of *Primitia*.

4. *PRIMITIA DORSICORNIS*, Ulrich, sp. Plate III, fig. 13.

1892. *LEPERDITIA DORSICORNIS*, Ulrich. Amer. Geologist, vol. x, p. 267, pl. ix, figs. 24—28.

*Description*.—Valve very small, flattish, short, sub-ovate. Dorsal border broken by a vertical projection behind a short sulcus. Free borders convex.

*Size*.—Length .5 mm.

*Locality*.—One small specimen from Saunton Hotel is in Miss Partridge's Collection.

*Remarks*.—This specimen Professor Rupert Jones considers sufficiently near to *P. dorsicornis* to be referred to it. It has some alliance to the accompanying *P. sparsinoda* (fig. 7), but that appears distinguished by the absence of a projecting node.

It appears to be a passage-form into the genus *Æchmina*, approaching *Æ. Byrnesi*, Miller,<sup>2</sup> but with a smaller and more vertical spine.

<sup>1</sup> 1890, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlv, p. 23, pl. i, figs. 13, 14.

<sup>2</sup> 1890, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlv, p. 12, pl. iii, figs. 9—11.

5. *PRIMITIA BOVIFRONS*, n. sp. Plate III, figs. 25—30.

*Description*.—Valve suboblong, elongate, flattish. Dorsal margin straight and equal to the length of the carapace. Ventral margin almost straight, oblique. Ends unequally rounded. Anterior portion rather narrower than the posterior. Valves with a broad, shallow central furrow, edged with two slight prominences, extending perpendicularly from the dorsal margin halfway down, and having a sharp elevated tubercle or horn standing out from the valve rather below the antero-superior corner, and in the extreme postero-dorsal angle another horn which is very lofty and tends upwards and backwards. Free margins bordered by a strong impressed rim (fig. 28). Surface covered by a coarse, irregularly honeycomb reticulation, with concave interspaces.

*Size*.—A large specimen is 4.2 mm. long, and 2.3 mm. high.

*Localities*.—In the Porter Collection is a slab containing four or five specimens from Pilton; and in my Collection are several specimens from the *Pecten nevilis* bed of the Laticosta Cave, Baggy, one of which (fig. 27) has been squeezed into a symmetrical shape.

*Remarks*.—This fossil is referred to the genus *Primitia* by my friend Professor Rupert Jones on account of its furrow, but he recognises that its central tubercles, which in some specimens are strongly developed, show a passage toward *Ulrichia*.

It was first known to me by Mr. Porter's specimen, the locality of which was indefinite, but I have since found it in plenty at Baggy Point together with other Ostracods.

6. *PRIMITIA VESTITA*, n. sp. Plate III, fig. 14.

? 1892. *LEPERDITIA MUNDULA*, *Ulrich*. Amer. Geologist, vol. x, p. 265, pl. ix, figs. 4—8.

*Description*.—Valve elongate, subovate or bean-shaped, rather flat. Dorsal border straight, nearly as long as the valve. End borders narrow, very convex, angular above and passing insensibly below into the long convex ventral border. Valve with a central oval node defined above and at the sides by an impressed furrow, and with very indistinct and diffused lateral lobes. Ornament of coarse elongated rugosities (not clearly shown in the figure) radiating from the central node. Rim indistinct, oblique or bevelled.



*Size*.—Length 2·2 mm.; height 1·3 mm.

*Locality*.—There is one specimen in the Porter Collection from Pilton, associated with a valve of *Strophalosia productoides*.

*Remarks*.—This species bears great resemblance in shape, ornament, and markings to *Beyrichia clathrata*, Jones,<sup>1</sup> though differing somewhat in each particular. It appears to stand about halfway<sup>2</sup> between that species and *Leperditia mundula*, Ulrich,<sup>3</sup> being nearer to the former in general contour and ornament and to the latter in outline. It is possibly the same as the latter, though it slightly differs from it in the size and shape of the furrow. In any case, however, as it evidently is a *Primitia*, and has no connection with *P. mundula*, Jones, we are obliged to retain our proposed name.

#### 4. Genus—BEYRICHIA, M'Coy, 1846.

##### 1. BEYRICHIA ÆQUILATERA, Hall? Plate III, fig. 15.

? 1860.	BEYRICHIA ÆQUILATERA,	Hall.	Canad. Nat. and Geol., vol. v, p. 158, fig. 20.
? 1868.	—	— Dawson.	Acad. Geol., ed. 2, p. 608, fig. 217.
? 1878.	—	—	Ibid., p. 609, fig. 217.
? 1890.	—	ÆQUILATERA, Jones.	Quart. Journ. Geol. Soc., vol. xlv, p. 18, pl. ii, fig. 6; and p. 552.
? 1891.	—	—	Canad. Micro-Palæont., pt. 3, p. 72, pl. xi, fig. 6.

*Description*.—Valve short, suboblong, convex. Dorsal border long, straight. Ventral border semicircular. Ends equal, gently and evenly curved. Valve with three subequal parallel lobes, separated by two narrow furrows.

*Size*.—Length 7 mm.

*Localities*.—Several specimens are in my Collection from Saunton Hotel.

*Remarks*.—The specimens are all very much squeezed out of shape; and, probably, the one figured has been shortened from that cause. On the whole, however, they seem to be distinguished by three elongate equal lobes.

*Affinities*.—It appears so closely to resemble *B. æquilatera*, Hall, as given by Jones, that I am inclined to think it identical.

<sup>1</sup> 1857, Jones, 'Ann. Mag. Nat. Hist.,' ser. 3, vol. i, p. 242, pl. ix, fig. 1.

<sup>2</sup> Dr. Holzapfel translates this phrase, which I used in vol. i, p. 10, in reference to a Trilobite, by the word "Mittelform," and then proceeds at great length to prove me incorrect in so calling it. The simple answer is that I never called it a "Mittelform" at all. In stating that in appearance it stood midway between two other species I in no way implied, or intended to imply, that it was a passage-form between them.

<sup>3</sup> 1892, Ulrich, 'Amer. Geol.,' vol. x, p. 265, pl. ix, figs. 4—8.



In *B. oculina*, Hall,<sup>1</sup> the central lobe seems separated below, and the lateral lobes coalesce beneath it.

Professor Rupert Jones has suggested a comparison of it with the specimen of *B. Klædeni*, M'Coy, figured by him in 1881.<sup>2</sup> It does not seem to me that the rather numerous though always distorted specimens I have seen show signs of conformability to that species. Their lobes are always long, straight, and evenly joined below.

*B. Steusloffii*, Krause,<sup>3</sup> seems to differ in the same manner.

*B. Wilckensiana*, Jones, as given by Krause,<sup>4</sup> seems to have thicker lobes, and a more elaborated anterior end.

## 2. BEYRICHIA DAMESII, Krause? Plate III, fig. 16.

1891. BEYRICHIA DAMESII, Krause. Zeitsch. Deutsch. Geol. Gesell., vol. xliii, p. 502, pl. xxxii, figs. 1—3.

*Description*.—Valve small, elongate, suboval. Ventral margin nearly straight. Ends obliquely convex. Valve having three subequal tubercles between two broad shallow furrows; the central tubercle being the most nodular, and the lateral tubercles indistinctly united below.

*Size*.—Length ·6 mm.

*Locality*.—One specimen from Pilton is in the Porter Collection.

*Remarks*.—This specimen is indistinct, but as far as can be seen it presents almost exactly the appearance of *B. Damesii*, and therefore I venture to refer it provisionally to this species.

*Affinities*.—To *B. concinna*, Jones and Holl,<sup>5</sup> it is very similar, but the lobes appear to be thicker in that species. Several of the varieties<sup>6</sup> of *B. Klædeni*, M'Coy,<sup>7</sup> are sufficiently like it to suggest that it possibly may prove nothing beyond a variety of that highly unstable species.

<sup>1</sup> 1890, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlvi, p. 16, pl. i, fig. 4.

<sup>2</sup> 1881, Jones, 'Geol. Mag.,' dec. 2, vol. viii, p. 337, pl. x, fig. 2.

<sup>3</sup> 1891, Krause, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xliii, p. 505, pl. xxxii, figs. 7—9.

<sup>4</sup> 1877, *ibid.*, vol. xxix, p. 25, pl. i, figs. 18 *a*, *b*.

<sup>5</sup> 1886, Jones and Holl, 'Ann. Mag. N. H.,' ser. 5, vol. xvii, p. 356, pl. xii, figs. 22 *a*, *b*.

<sup>6</sup> 1886, *ibid.*, p. 349, pl. xii, figs. 3, 4; and 1893, Jones, 'Quart. Journ. Geol. Soc.,' p. 301, pl. xiv, fig. 3.

<sup>7</sup> 1846, M'Coy, 'Syn. Sil. Foss. Ireland,' p. 58, woodcut.

5. Genus—BEYRICHIOPSIS, Jones and Kirkby, 1886.

1. BEYRICHIOPSIS RUPERTI, n. sp. Plate III, fig. 17.

*Description*.—Valve rather long, suboblong, flattish. Dorsal margin straight, equal to about two-thirds of the length. Ventral margin nearly straight, horizontal. Ends semicircular. Valve with (1) a small anterior lobe close to the dorsal edge and defined behind by an oblique sulcus; (2) a small indistinct ventrally situated convexity, and (3) a large diffuse posterior lobe bearing in the dorsal corner a small tubercle; and (4) several longitudinal ridges on different parts of the surface. Border bearing a narrow fringe.

*Size*.—Length .8 mm.

*Locality*.—There is one specimen from Pilton in the Porter Collection.

*Remarks*.—It appears to me that this small fossil answers all the requirements of the genus *Beyrichiopsis*, though it was only after the drawing had been made that further examination brought out its true characters, and therefore they are not well seen in the figure.

*Affinities*.—The smaller size and different position of the lobes distinguish it from *B. fimbriata*, Jones and Kirkby,<sup>1</sup> and *B. fortis*, J. and K.,<sup>2</sup> and *B. subdentata*,<sup>3</sup> J. and K. The large subcentral boss in these species seems to be barely represented in ours.

6. Genus—KLÆDENIA, Jones and Holl, 1886.

1. KLÆDENIA BURSÆFORMIS, n. sp. Plate III, figs. 18—23.

A series of variously distorted valves from a ferruginous weathered face of limestone assume very diverse appearances, but probably all belong to one species to the true shape of which figs. 18 and 21 perhaps represent the nearest approaches.

*Description*.—Valve subovate, flattish. Dorsal edge long, straight, nearly as long as the valve. Postero-superior corner angular. Free edges gently convex and bordered with a narrow rim. Anterior portion of the valve narrow. Valve with two deep broad furrows, extending from the back for a greater or less distance downwards and separating three elevated lobes, of which the first and

<sup>1</sup> 1886, Jones and Kirkby, 'Geol. Mag.', dec. 3, vol. iii, p. 434, pl. xi, figs. 3—10.

<sup>2</sup> Ibid., p. 435, pl. xii, figs. 1—3.

<sup>3</sup> Ibid., p. 437, pl. xii, figs. 1, 2.

third coalesce below, while the central lobe seems sometimes more defined. Posterior lobe sometimes bifid.

*Size*.—Length 1.5 mm.

*Locality*.—Numerous specimens from the Ostracod Bed, Laticosta Cave, Baggy (where it seems to occur frequently) are in my Collection.

*Remarks*.—This species seems variable, but the variation is partly to be accounted for by the immense squeezing and twisting which the beds have undergone, as seen by the shapes assumed by larger fossils. Hence it is hard to arrive at the true form of the species. The specimens numbered 22 and 23 are examples of shortened aspects it assumes under distortion, and at first sight appear to belong to different genera, but on examination prove to be the present species. On the other hand elongate valves with faint ridges, represented by figs. 19 and 20, occur frequently; it seemed at first that these must be distinct, but on tracing out the differences seen in numerous specimens it becomes evident that they are simply due to fossilisation, and that they cannot be separated from the rest even as a variety.

*Affinities*.—*Klædenia notata*, sp., Hall,<sup>1</sup> seems not unlike, and possibly under varying pressures would present similar forms.

## 7. Genus—ULRICHIA, Jones, 1890.

### 1. ULRICHIA INTERSERTA, n. sp. Plate III, fig. 24.

*Description*.—Valve long, semi-oval. Dorsal border straight, almost as long as the valve. Ventral border elliptic. Ends rather strongly and evenly rounded; with thickened margins rising up from the ventral border. Surface bearing two large, prominent, obliquely oval, median well-defined lobes, not united below.

*Size*.—Length .8 mm.

*Localities*.—There is one specimen in my Collection from the Ostracod bed at Baggy.

*Remarks*.—This fossil is regarded by Rupert Jones as an *Ulrichia*. It appears, however, to mark a passage from that genus to *Bollia*; for, while the lobes are distinctly defined below, there is a decided thickening of the lower portion of the valve. This passage between the two genera is continued by *Bollia bilobata*, Jones,<sup>2</sup> which has equally large lobes, united by a low swelling. The latter is also distinguished by being more oblong.

<sup>1</sup> 1890, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlv, p. 13, pl. iv, figs. 22, 23, and var., fig. 24.

<sup>2</sup> 1890, Jones, 'Quart. Journ. Geol. Soc.,' vol. xlv, p. 540, pl. xx, fig. 12.



*Beyrichia devonica*, Jones and Woodward,<sup>1</sup> is very much larger and longer, and has more confluent lobes.

# MOLLUSCA, Cuvier, 1812.

CLASS—CEPHALOPODA, Cuvier, 1798.

ORDER—TETRABRANCHIATA, Owen, 1832.

SUB-ORDER—AMMONOIDEA, D'Orbigny, 1840.

I. *Family*—GONIATITIDÆ, Gray, 1840.

1. *Genus*—GONIATITES, de Haan, 1825.

*Sub-genus*—AGONIATITES, Meek, 1877.

## 1. AGONIATITES, sp. Plate IV, fig. 2.

*Description*.—Shell of moderate size, discoid, flattish. Umbilicus rather small, shallow, open. Whorls rising steeply from the umbilicus, turning immediately through nearly a right angle to form a sub-angular elbow, and then spreading out flatly towards the back, and bearing on the elbow (or margin of umbilicus) a few slight undefined radiating nodules. Suture arching backwards from the elbow or umbilical margin in a simple lateral saddle for more than half the width of the whorl.

*Size*.—Diameter about 30 mm.

*Locality*.—A single imperfect specimen from Kingdon's, Shirwell, is in the Barnstaple Athenæum.

*Remarks*.—Though a portion only of this shell is visible in the matrix, Mr. Crick points out to me that it evidently, from what is seen of its suture-line, belongs to the group or genus *Agoniatites*, and is closely allied to *Agoniatites transitorius*, Phillips, sp. There are also slight signs of transverse lineations as in that species, but it differs from it by having nodules or swellings on the margins of the whorls just round the umbilicus.

*Affinities*.—*G. Roemerii*, Holzapfel,<sup>2</sup> has a smaller umbilicus, more sloping sides, and no nodulations.

<sup>1</sup> 1889, Jones and Woodward, 'Geol. Mag.,' dec. 3, vol. vi, p. 386, pl. ix, figs. 3—5.

<sup>2</sup> 1882, Holzapfel, 'Palæontographica,' vol. xxviii, p. 234, pl. xlv, figs. 1—1 b.



## 2. GONIATITES, sp. Plate IV, figs. 1, 1 a.

*Description*.—Shell very small, globose. Umbilicus minute, deep. Sides of the whorls rising from the margin of umbilicus for a short distance in a gentle curve, and then arching round still more gently to form a broad, regular, and very moderately convex back. Suture-lines unseen. Sulci three (two only being distinctly visible) straight, crossing the whorls perpendicularly.

*Size*.—Diameters 10 mm. and 9 mm.; width 6 mm.

*Locality*.—Two small specimens from Barnstaple are in the Woodwardian Museum.

*Remarks*.—These specimens, which from the nature of their matrix evidently come from the Pilton beds, show little beyond the general form of the species, the chief feature of which is the convexity of the sides as they rise from the umbilicus. The shell is very closely coiled, the backs of succeeding whorls having little room between them, so that the shape of the shell-cavity must have been highly lunate, and the whorls numerous.

*Affinities*.—*Goniatites micromphalus*, F. A. Römer,<sup>1</sup> of the Wissenbach slates, differs in having the margin of the umbilicus higher and more angular.

Mr. Crick and I compared the specimens with Carboniferous examples of *G. crenistria* (the name these specimens had borne in the Museum), and came to the conclusion that it was in no way connected with that shell. With *G. linearis*, Münster, as given by Phillips, it may have more in common, but I am not certain whether the rounding-in of the shell round the umbilicus occurs in that species.

## SUB-ORDER—NAUTILOIDEA, d'Orbigny, 1826.

## I. Family—NAUTILIDÆ, Owen, 1836.

## 1. Genus—SUBCLYMENIA, d'Orbigny, 1849.

“This genus differs from *Discitoceras* (*Discites*) in the sutures and position of the siphon. The sutures have a deep v-shaped ventral and acute linguiform first pair of saddles, first pair of lateral lobes narrow, a second pair of small lateral saddles near the umbilical shoulders, and dorsal saddles divided by shallow annular lobes with a minute median saddle. The abdomens are hollow, and the dorsal region gibbous, as in the adults of *Aphelæceras*. The siphon is near the venter, but the

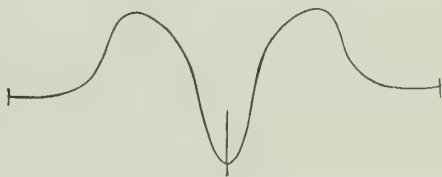
<sup>1</sup> 1850, F. A. Römer, ‘Beitr. Harzgeb.’ pt. 1, p. 19, pl. iii, figs. 30 a, b.

funnels do not approach near enough to interrupt the sutures or affect the depth of the ventral lobes. But one Carboniferous species is known—*S. evoluta*, Phil.”<sup>1</sup>

De Koninck proves this genus to belong to the Nautilidæ.

1. SUBCLYMENIA SYMONDSII, MS. Plate VII, figs. 3, 3 a, 4.

*Description*.—Shell very large, discoid, flattish, of two or three volutions, which appear probably to have been free, and to leave a central vacuity. Whorls rapidly increasing, sub-quadrate, nodose; ventrally broad, concave; dorsally narrow, slightly concave. Sides convex, rising slowly from their dorsal side to the shoulder for about two-thirds their height, and then curving down to the ventral side, where they seem bounded by a sharp angle; barred by distant ridges



which swell into large lofty bluntly conical nodes, at the shoulder, about twelve nodes to a whorl. Body-chamber probably large. Suture-line with a very long V-shaped central saddle, rather deep and convex central lobes, and low lateral saddles. Ornament consisting of small, crowded, unequal, rounded transverse riblets, divided by narrower grooves, running slightly backward from the inner margin to the shoulder, where they vanish; crossed by comparatively few distant impressed threads, which are absent on the shoulder but reappear on the ventral part of the side. Shell-structure probably not massive.

*Size of cast*.—Diameters 165 mm. and 110 mm. Width 65 mm.

*Locality*.—In the Museum of Practical Geology are two specimens from Luscott, near Branton, one of which is a very large cast retaining in one place signs of the surface-markings, and the other the mould or inner surface of a smaller shell.

*Remarks*.—The largest specimen in the Museum is a splendid fossil, but in many respects it is most difficult to interpret. In the first place it has evidently been subjected to very great slant pressure, which has compressed it, altered the character of its coiling, and obscured the true shape of its whorls. Again, its whorls are so widely separated that it is difficult to imagine that they were in contact unless the shell-structure were immensely thick, which the fact of the cast bearing traces of the surface-ornament renders very improbable. Moreover,

<sup>1</sup> 1884, Hyatt, 'Proc. Boston Soc. N. H.,' vol. xxii, p. 293.

the stone is so covered with cracks and inequalities that anything in the nature of sutures is most difficult to trace. Lastly, several of the nodes on one side are removed by clean-cut concavities in such a way as almost to suggest that it had agglutinated foreign substances after the manner of *Philoxene*.

The species has been quoted in catalogues under the name of *Porcellia Symondsii* in accordance with the old label which the fossil bore in the Museum. Repeated examinations, however, convinced me that it was impossible that it could belong to that genus. Being struck with its great likeness to a Cephalopod, I then consulted Mr. Crick upon the subject, and his practised eye succeeded in tracing several of the suture-lines, and thus settling not only its order but its genus. This at once elucidated several of the perplexities about the fossil. It became evident that its elliptic shape was wholly due to pressure, and also that the same cause had probably exaggerated the originally broad, gently concave ventral surface into a narrow and deeply concave groove. Further, on our examining the specimen figured by Phillips<sup>1</sup> as *Nautilus tetragonus* (= *Discites Omalianus*, de Koninck,<sup>2</sup> sp., according to Foord<sup>3</sup>), which Hyatt refers to *Subclymenia*, it was seen that the surface-ornament, though not identical, was of such a kindred nature as to confirm Mr. Crick's conclusion.

*Affinities*.—Our species is at once distinguished from the type species of the genus, *S. evoluta*, Phillips, sp.,<sup>4</sup> with which de Koninck<sup>5</sup> afterwards identified his *Nautilus Omalianus*, by the presence of nodes.

## II. Family—GOMPHOCERATIDÆ, Pictet, 1854.

### 1. Genus.—POTERIOCERAS, McCoy, 1844.

#### 1. POTERIOCERAS ? sp. Plate IV, figs. 3, 3 a.

*Description*.—Shell apparently short, very rapidly tapering, recurved. Section quadrately sub-ovate, wider than deep. Siphuncle small, circular, 1 mm. in diameter, sub-central, being rather near to the convex side. Body-chamber expanding. Septate part apparently rapidly expanding, consisting of very narrow chambers, 3 mm. in height, with rather shallow concave septa, rather oblique, sloping slightly down (?) toward the convex side. Test thin.

*Size* of fragmentary specimen: height 40 mm.; transverse diameters 26 mm. and 30 mm.

<sup>1</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 233, pl. xvii, fig. 24; and pl. xxii, figs. 33, 34.

<sup>2</sup> 1851, de Koninck, 'Desc. Anim. Foss. Terr. Carb. Belg.,' Suppt., p. 61, pl. lx, fig. 3.

<sup>3</sup> 1891, Foord, 'Catal. Foss. Cephal. Brit. Mus.,' pt. 2, p. 87.

<sup>4</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 237, pl. xx, figs. 65—68.

<sup>5</sup> 1880, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. v, pt. 2, p. 83, pl. xlv, figs. 5—6 a.



*Locality*.—A specimen from Kingdon's, Shirwell, is in the Barnstaple Athenæum.

*Remarks*.—This is evidently a species of either *Poterioceras* or possibly *Gomphoceras*. Its more central siphuncle (which is situated at a point 10:16 on the transverse diameter) distinguishes it from the various species found in South Devon; but the only specimen of it is unfortunately far too imperfect for identification.

## 2. POTERIOCERAS ? sp. Plate IV, fig. 5.

1841. ORTHOCERAS IMBRICATUM, *Phillips* (not *Hisinger*). Pal. Foss., p. 111,  
pl. xlii, fig. 207.

not 1890. — CHAMPERNOWNI, *Whidb.* Mon. Devon. Faun., vol. i, p. 142,  
pl. xv, figs. 11, 12.

*Size of fragmentary specimen*: width 36 mm. by 21 mm.

*Locality*.—Phillips's figured specimen from Marwood is in the Museum of Practical Geology.

*Remarks*.—This specimen is as poor as well could be,—consisting of eight crushed chambers from which the external parts are gone. It affords us little knowledge of the shell, except that it shows that there is a distinct wide shallow sinus or bay in the front margins of the septa, which I had not observed in the South Devon specimens, and hence that one point of difference in Phillips' shell from *Actinoceras Sowerbyi*, M'Coy, is removed, though on the other hand the almost exactly central position of the siphuncle is confirmed.

From the apparent rapidity of tapering in the above specimen, it seems to me most probable that it will, after all, prove to be distinct from the South Devon *O. Champernowni*, and to belong to *Poterioceras* or *Gomphoceras*.

## III. Family.—ORTHOCERATIDÆ, *Broderip*, 1839.

### 1. Genus.—ORTHOCERAS, *Breyn*, 1732.

#### 1. ORTHOCERAS, sp.

cf. 1839. ORTHOCERAS LUDENSE, *Sowerby*. In Murchison's Silurian Researches,  
p. 619, pl. ix, fig. 1.

1841. — — *Phillips*. Pal. Foss., p. 110, pl. xlii, figs. 206 a—c.

1855. — STRIATUM, *M'Coy*. Brit. Pal. Foss., p. 405.

? 1888. ACTINOCERAS STRIATUM ? *Foord*. Catal. Foss. Cephal., p. 187.



*Description*.—Shell very large, decreasing slowly at the rate of 1 : 12. Section oval, in ratio, 8 : 7. Chambers narrow, being in height about one seventh or one eighth the width of the shell. Septa sloping very obliquely across the short diameter. Siphuncle sub-circular, about one half an inch in diameter, sub-central, consisting of long vasiform or ellipsoidal beads, suddenly constricted into narrow concave necks at the septa, their greatest and least widths being as 7 : 5. Test about 3 mm. thick (in largest specimen), showing no markings.

*Size*.—A large specimen is five inches by three and a half inches in transverse diameters, but is probably slightly compressed.

*Locality*.—A large specimen from Top Orchard Quarry is in the Barnstaple Athenæum, and another, slightly smaller, from "North Devon" in the British Museum. The original of Phillips's figured specimen (fig. 206 *b*) from the Pilton Beds is in the Museum of Practical Geology.

*Remarks*.—These specimens are fragmentary and insufficient to identify the species, which evidently was very large, probably several feet in length. Whether the other specimen figured by Phillips (fig. 206 *a*) is identical I am not quite sure, as, according to its figure, its tapering is more rapid, viz. 1 in 5 or 6 instead of 1 in 12; but it is possible that this apparent difference may be due to accidental circumstances.

Neither is it at present clear that these Devonian fossils have any right to the name of Sowerby's Silurian *O. Ludense*.

Until more is known about its specific characters, it appears safer not to attempt to identify it with species belonging to a different formation.

It appears from the character of its siphuncle properly to belong to the genus *Orthoceras*, and is therefore probably distinct from the Lummston species described by me as *Actinoceras devonicans*,<sup>1</sup> and from *A. striatum*, with which M'Coy<sup>2</sup> and Foord<sup>3</sup> had doubtfully identified it.

*Affinities*.—*Orthoceras Pelops*, Hall,<sup>4</sup> appears to equal it in size, and to be similar in many characters, but we have not sufficient data for full comparison.

## 2. ORTHOCERAS SPECIOSUM, Münster. Plate IV, fig. 4, 4 *a*.

1888. ORTHOCERAS, sp., Foord. Catal. Foss. Cephal., pt. 1, p. 98.

1890. — SPECIOSUM Whidborne. Dev. Faun., vol. i, p. 149, pl. xv, figs. 7 ? , 8—10.

<sup>1</sup> Vol. i, p. 120, pl. xii, figs. 8, 8 *a*.

<sup>2</sup> 1852, M'Coy, 'Brit. Pal. Foss.,' p. 405.

<sup>3</sup> 1888, Foord, 'Catal. Foss. Ceph.,' vol. i, p. 187.

<sup>4</sup> 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 233, pl. xxxv, figs. 1—3; pl. xxxva, figs. 1—6; pl. xxxvii, figs. 3, 4; pl. lxxviiiB, fig. 2.

*Localities.*—In the Barnstaple Athenæum are four specimens from Kingdon's, Shirwell, a doubtful specimen from Top Orchard, and two more without localities; in the Museum of Practical Geology are two poor specimens from Marwood, one from Baggy, and one from West Angle Bay, Pembrokeshire; in the British Museum is one from Kingdon's, Shirwell; and in the Woodwardian three from Barnstaple.

*Remarks.*—It appears to me that the Shirwell specimens undoubtedly belong to this species. Their surface is smooth; their section slightly oval (10 : 8); the siphuncle central and rather large; the ratio of the height of the chambers to their width 2 : 5 or 2 : 6; the rate of tapering about 1 in 8. The specimen from that locality in the British Museum is a body-chamber which is 110 mm. long and 36 mm. wide, and appears sub-cylindrical with a rate of tapering of only 1 in 12.

In the specimen from West Angle the shell-structure is rather thick, and the surface though smooth to the naked eye is seen under a strong lens to be covered with multitudinous microscopic impressed lines of which a few are slightly stronger than the rest; a faint carina is seen on its cast similar to that figured on a specimen from Lummaton.<sup>1</sup>

F. A. Römer's<sup>2</sup> version of *Orthoceratites regularis*, Schlotheim,<sup>3</sup> seems to be very similar to this species, but that form has much loftier chambers.

*O. lineare*, Münster, appears to differ in having fine elevated transverse threads instead of simple lineations which do not alter the level of the surface.

### 3. ORTHOCERAS BARUMENSE, n. sp. Plate IV, figs. 7, 7 a, 8, 8 a, 8 b.

*Description.*—Shell generally small, vertically straight, elongate, conical, probably tapering at about the rate of 1 in 10, covered by elevated, broad, slightly oblique, arching, convex, undefined rings at the rate (in the wider part) of four rings in a height equal to their width, which are separated by shallow concave constrictions about twice as wide as the rings. Septa gently convex, slightly oblique. Section circular or sub-circular with diameters as 9 : 10. Siphuncle rather large, very nearly central. Chambers broad, being apparently about one half their width in height in the smaller part (and probably decreasing to one quarter their width in height when nearer the body chamber). Surface of the shell entirely covered by minute, sharp, crowded, regular, distant, elevated, transverse threads or striæ, which sometimes slightly undulate, and are at the rate of nine striæ to 1 mm.

<sup>1</sup> Vol. i, pl. xv, fig. 9.

<sup>2</sup> 1843, F. A. Römer, 'Verst. Harzgeb.', p. 35, pl. x, figs. 4, 5, 8,

<sup>3</sup> 1820, Schlotheim, 'Petrefact.', p. 24.

*Size*.—One specimen about 3 mm. in width is 20 mm. long. The largest fragment I have seen is about 11 mm. wide.

*Localities*.—In the Barnstaple Athenæum is a small specimen from Brushford; in my Collection one from Ironpost near Dulverton, one from Frankmarsh, and one from Upcott Arch Quarry; in Miss Partridge's Collection one from Lower Orchard Quarry.

*Remarks*.—At first it seemed that two species were represented by these fossils, the elevated annuli not being noticeable in the smaller specimens. After a careful comparison, however, it appears that they are all identical. The annuli probably became more prominent with the growth of the shell. They were probably conterminous with the chambers, as in one instance they appear to have been so, and if this is the case the height of the chambers varied from one half to one quarter the width of the shell. The ornamentation though minute is very definite, consisting of sharp striations considerably more than their own diameter apart and sometimes occurring in bands of three or four of greater fineness than usual.

*Affinities*.—From *O. lineare*, Münster,<sup>1</sup> which is similarly lineated, this species is distinguished by the possession of annuli. From *O. ibex*, Sowerby,<sup>2</sup> and *O. articulatum*, Sowerby,<sup>3</sup> it differs in the absence of longitudinal striæ. The same character seems to distinguish it from all the American Devonian forms.

*O. ulbense*, Tschernyschew,<sup>4</sup> agrees in form and rate of tapering; but probably differs in having fewer minor striæ, and wider and more horizontal chambers, and in being larger.

*O. vertebratum*, Sandberger,<sup>5</sup> appears to differ in the striæ being intermittent, and perhaps in the annuli being larger.

#### 4. ORTHOCERAS VENNENSE, Foord.

- |       |                                   |  |
|-------|-----------------------------------|--|
| 1840. | ORTHOCERAS CYLINDRACEUM, Sowerby. | Geol. Trans., ser. 2, vol. v, p. 703,*<br>pl. lii, figs. 6, 7. |
| 1841. | — — —                             | Phillips. Pal. Foss., p. 113, pl. xliii, figs.<br>213 a—c.     |
| 1888. | — VENNENSE, Foord.                | Catal. Foss. Cephal., vol. i, p. 85.                           |

<sup>1</sup> 1840, Münster, 'Beitr.', pt. 3, p. 99, pl. xix, fig. 1.

<sup>2</sup> 1839, Sowerby, in Murch. 'Sil. Syst.', p. 613, pl. v, fig. 30.

<sup>3</sup> Ibid., p. 613, pl. v, fig. 31.

<sup>4</sup> 1893, Tschernyschew, 'Verhandl. Russ. Miner. Gesell.', vol. xxx, p. 18, pl. iii, figs. 1 a b.

<sup>5</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 170, pl. xx, figs. 3—3 c; and 1876, Maurer, 'Neues Jahrb. f. Min.,' Ann. 1876, pp. 12 and 23.



*Size*.—30 mm. long; 5 mm. wide.

*Locality*.—One specimen from the Marwood Beds of Baggy Point is in the Barnstaple Museum.

*Remarks*.—The only specimen known to me from the Pilton beds is too poor and doubtful to be worth figuring. Its septa are very unequal, and are often more than half the diameter of the shell in height; though on the whole they seem rather narrower than is usual in Sowerby and Phillips's figures. Phillips compares it with *O. regulare*, Münster,<sup>1</sup> to which it is rather similar in some respects.

It is recorded by Phillips from the Carboniferous localities of Venn and Swimbridge, as well as doubtfully from Baggy Point.

*Affinities*.—From *O. speciosum* it differs by its very much broader and more unequal chambers.

##### 5. ORTHOCERAS, sp. Plate IV, fig. 6.

*Description*.—Shell small, straight, tapering at the rate of 1 in 7. Septa slightly oblique. Chambers about one quarter the width of the shell in height. Siphuncle (or endosiphon?) beaded, being constricted just below the septa into narrow necks about half its width, and then swelling out into convex-shouldered, straight-sided beads which are rather wider above than below, have rather stout walls and a microscopically rugose surface, and are clothed with a subsidiary envelope (or exterior siphuncle?). Subsidiary envelope dumb-bell-shaped, being very wide above and suddenly narrowing at about one-quarter its length below the septa, its sides then becoming straight and then sometimes (?) slightly expanding just above the next septum.

*Size*.—A defective specimen is 30 mm. high by 8 mm. wide.

*Locality*.—A single specimen from Kingdon's, Shirwell, is in the Barnstaple Athenæum.

*Remarks*.—This specimen only showing the section of the shell, it is almost impossible to identify it specifically. It seems, however, to be distinguished from accompanying species by the different height of its chambers, so that it probably represents a distinct species.

It seems remarkable for the arrangement of its siphuncular apparatus, which in superficial shape exactly resembles that of *Huronia*. It is seen, however, that the external envelope is entirely filled with white calcareous spar, and instead of a linear endosiphon with expanding tubuli it contains a simple and entire beaded tube. This tube Mr. Crick, who has very carefully examined the specimen with me, regards as the true siphuncle. This being so, the exterior envelope, though

<sup>1</sup> 1840, Münster, 'Beitr.', pt. 3, p. 95, pl. xvii, fig. 4.



evidently bounded by true walls, must be regarded as an organic deposition after the manner of those figured in some species of *Orthoceras* by Barrande.

Hence it appears that whatever the species may be, it probably belongs to the genus *Orthoceras*.

## 2. Genus—ACTINOCERAS, Bronn, 1837.

### 1. ACTINOCERAS? (HURONIA) CRICKII, n. sp. Plate IV, figs. 9? 10—12.

*Description*.—Shell rather large, straight, tapering rather rapidly at the rate of about 1 : 6. Section elliptic, having the siphuncle situated excentrically, rather in front of the centre along the longer diameter, and considerably distant from the centre along the shorter diameter. Chambers narrow, very slightly oblique, and about one-sixth of the width of the shell in height. Septa shallow, convex, somewhat steeper in front, and having a wide, very shallow bay or sinus on the side farthest from the siphuncle. Siphuncle very large, about two-fifths the width of the shell; consisting of a series of subturbinate or vasiform rosettes, rather wider than high, which sometimes appear thickened by organic (?) deposits; and containing in its centre a slight free subcylindrical endosiphon. Endosiphon suddenly expanding just below the top of each rosette into about four radiating horizontal tubuli, which branch into minor tubuli near their extremities, are supported by ridges below, and are more or less joined to each other by their lateral expansions. Septa meeting the siphuncle only a little below its widest part, and enfolding its lower portion. [? Surface (on the cast) showing a long longitudinal carina and signs of rather distant alternating threads or striæ, fig. 9.]

*Size*.—A specimen of twenty chambers is 80 mm. long by 25 mm. wide; another, of about eleven chambers, is 55 mm. long by 27 mm. wide.

*Localities*.—Of external casts, probably belonging to this species, are two specimens from Top Orchard, three from Pilton Vicarage Well, and one from Fremington in the Barnstaple Athenæum; one from Baggy in the Museum of Practical Geology; two from Pilton in the Porter Collection; and two from Barnstaple and one from the south-west of Sloly in the Woodwardian Museum. Of natural sections showing the siphuncle there is one "from Yeotomes" in the the Barnstaple Athenæum; one from Croyde and one from Barnstaple in the Woodwardian Museum; and one from the Marwood Beds in the British Museum.

*Remarks*.—Most of the exterior specimens are very poor, and some are very doubtful, and could hardly be identified specifically by themselves; but from the dimensions of their chambers and other points they appear most probably to

belong to the same species as the remarkable natural sections last enumerated. Signs of the ornament are only seen in a single specimen from Baggy, but they appear sufficient to show its distinctness from the South Devon *O. laterale*, Phillips.

The internal arrangements seem peculiarly perplexing; while they approximate those of *Actinoceras*, they appear to present several characteristics strongly indicative of the Lower Silurian genus *Huronia* as differing from *Actinoceras* itself, *e. g.* (1) in the vasiform shape of the rosettes; (2) in having the tubuli not in the centre but at the summit of the rosettes; (3) in the rosettes not being interseptal, but sunk into the bases of the septa; (4) in the sides of the siphuncle being probably unsymmetrical, one side appearing as though it were more evenly nummuloid than the other; (5) in the siphuncle possibly not occupying a symmetrical position in the shell. On the other hand, in the present species the septa and shell are generally preserved, having only perished in one specimen, whereas in *Huronia* they are hardly ever preserved.

Mr. Crick has most kindly taken much trouble in comparing these sections with Cephalopods in the British Museum, and we together came to the conclusion that they were so exceedingly like *Ormoceras vertebratum*, Hall,<sup>1</sup> = *Ormoceras Bayfieldi*, Stokes,<sup>2</sup> as in all probability to be congeneric. Hence the question arises, as *O. vertebratum* is the type of the genus *Ormoceras*, whether that genus ought to be united to *Actinoceras* after Foord or to *Huronia*. Mr. Crick regards Stokes's type (which is in the British Museum) as very enigmatical, but its structure seems to correspond with, and to be explained by, our specimens; and it would seem, if we read the present species correctly, that *Ormoceras* is only *Huronia* in a different state of preservation, and that therefore *Huronia* has as much right as *Ormoceras* to be classed as a synonym, or perhaps a group, of *Actinoceras*.

The fact that in *Huronia* the siphuncle is almost always the only part preserved, which is said to prove the extreme tenuity of the shell, does not seem a bar against this, for it is easy to imagine that some species of the genus might have had thinner shells than others, or that shells in a siliceous deposit might have more easily perished than a limestone. Moreover in one of our own sections the siphuncle is the only part preserved, and in the other three the shells are retained in a very imperfect and indistinct condition. It may be noted that Stokes has, on the same plate as his *Ormoceras*, figured two sections of *Huronia*, which seem extremely like our fossils.

At the same time there can be no doubt that the general affinities of this species to *Actinoceras* are very great, and if the relationships to *Huronia* above noted be verified by future specimens they will probably be found to be evidence

<sup>1</sup> 1852, Hall, 'Pal. N. Y.,' vol. ii, p. 94, pl. xix, figs. 1 a—g.

<sup>2</sup> 1840, Stokes, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, p. 709, pl. lx, fig. 1.

not that *Huronia*, as distinct from *Actinoceras*, existed in the Devonian, but that *Huronia* itself is merely a condition or, at most, a group of the genus *Actinoceras*.

Taking these sections in connection with the probable indications of external ornament, there seem to be sufficient characters known to warrant the suggestion of a name for the species.

*Affinities.*—The large *Orthoceras Ludense*, Phillips (not Sowerby), from these beds seems distinguished by its much greater size, wider chambers, and the shape of its siphuncle.

*Actinoceras striatum*, Sowerby<sup>1</sup> (= *O. lineale*, de Koninck<sup>2</sup>), differs in having much finer and more numerous equal lineations. It may be noted, however, that in the Woodwardian Museum there are specimens from Mudstone Bay and from Mawgan, which seem, in the few points visible, exactly like our fossils, and which are there labelled *Orthoceras striatum* (probably on the authority of Prof. M'Coy).

*A. subconicum*, d'Orbigny,<sup>3</sup> is, as figured originally by Sowerby,<sup>4</sup> remarkably like our sections, but has narrower chambers and more central tubuli.

## CLASS—GASTEROPODA, Goldfuss, 1820.

### 1. ORDER—PTEROPODA, Cuvier, 1798.

#### I. *Family*—CONULARIIDÆ, Walcott, 1890.

##### 1. *Genus*—CONULARIA, Sowerby, 1818.

#### 1. CONULARIA DEFLEXICOSTA, Sandberger? Plate IV, fig. 13.

? 1847. CONULARIA DEFLEXICOSTA, G. Sandberger. Bronn's Jahrb., Ann. 1847, p. 16, pl. i, fig. 6.

? 1853. — — Sandberger. Verst. Rhein. Nassau, p. 243, pl. xxi, figs. 1, 1 a.

? 1879. — CONTINENS, var. RUDIS, Hall. Pal. N. Y., vol. v, pt. 2, p. 215, pl. xxxiv A, figs. 7, 8.

*Description.*—Shape probably a rather short pyramid. Faces without a central groove, but probably with a deep (angular?) marginal channel. Striæ distant,

<sup>1</sup> 1814, Sowerby, 'Min. Conch.,' vol. i, p. 129, pl. lviii; and 1888, Foord, 'Catal. Foss. Cephal.,' pt. 1, p. 190.

<sup>2</sup> 1880, de Koninck, 'Ann. Mus. Roy. N. H. Belg.,' vol. v, p. 79, pl. xli, figs. 9—9 c; and pl. xliii, figs. 8—8 e.

<sup>3</sup> 1849, d'Orbigny, 'Prodrome,' vol. i, p. 2.

<sup>4</sup> 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 642, pl. xxi, fig. 21.



about  $\frac{2}{3}$  mm. apart, elevated, coarse, sloping upward, and curving in the centre so as sometimes to alternate and interlock at an angle of about  $160^\circ$ , or sometimes to meet in a continuous curve; alternating and interlocking at the margins. Interstrial spaces about four times the width of the striæ, transversely but irregularly lineated inside, and showing signs of coarse crenulation within immediately under the striæ, and very fine oblique lines on the outer surface.

*Locality*.—One specimen from Pilton is in the Porter Collection.

*Remarks*.—While this fossil gives abundant evidence that it belongs to the genus *Conularia*, it is insufficient for very definite determination. It is flattened and too fragmentary to show its exact shape, and the inner surface is the only part well displayed. At the same time several characters are more or less clearly indicated. Besides the points which are at first sight apparent, there may be observed signs of a deep angular grooving at the corners, and in one portion, where the cast of the outside surface seems exposed, a very fine and oblique lineation is visible, which may, however, be partly due to accident. The striæ are not perfectly regular, seventeen on one side of a face corresponding to twenty on the other.

In the points observable it appears so closely to resemble *C. deflexicosta*, Sandberger, that these seem sufficient reason to refer it (presumptively) to that species.

*C. continens*, var. *rudis*, Hall, seems only to differ from Sandberger's figure in being more strongly ornamented, and being rather shorter in shape, and in these points perhaps more nearly resembles our specimen.

*Affinities*.—Of the species described by d'Archiac and de Verneuil it seems most nearly to resemble *C. ornata*,<sup>1</sup> but its striæ are not so strongly angulated, while those of *C. Brongniarti*, d'Arch. and de Vern.,<sup>2</sup> are centrally continuous.

*C. Salinensis*, Whiteaves,<sup>3</sup> has much coarser and fewer tubercles.

## II. Family—TENTACULITIDÆ, Walcott.

### 1. Genus—TENTACULITES, Schlotheim, 1820.

#### 1. TENTACULITES CONICUS, F. A. Römer. Plate IV, figs. 14, 14 a, 14 b.

1850. TENTACULITES CONICUS, F. A. Römer. Beitr. Harz., pt. 2, p. 80, pl. xii, figs. 20 a, b.

<sup>1</sup> 1842, d'Archiac and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 352, pl. xxix, figs. 5, 5 a.

<sup>2</sup> Ibid., p. 352, pl. xxxi, figs. 6—6 c.

<sup>3</sup> 1891, Whiteaves, 'Cont. Canad. Pal.,' vol. i, pt. 3, p. 244, pl. xxxii, figs. 9, 9 a.



*Description.*—Test conical, rather elongate, regular, slightly oblique. Section apparently circular. Rate of increase 1 in 3. Surface divided by about twenty-two sharp, raised, slightly irregular annuli, which are not quite parallel near the aperture; with slightly concave, wide interspaces, which are finely and obliquely striated from right to left (thus / / /) when viewed with the apex at the bottom.

*Size.*—Height 7 mm., width at aperture 2·5 mm.

*Locality.*—A single specimen, mould and cast, from Top Orchard is in the Barnstaple Athenæum.

*Remarks.*—The specimen is somewhat crushed, so that it is not possible to be certain that it was circular in section; and from the roughness and decomposition of the matrix the oblique striation can only be seen with great difficulty.

It is evidently a Tentaculite, and so closely approaches *Tentaculites conicus*, F. A. Römer, of the Wissenbach Slates, that I think it may probably be referable to that species. The only differences I can see are that the German fossil is slightly more elongate, increasing at the rate of two in seven instead of two in six, and that the striation is not seen in the figures. The latter is, however, so very minute that it might very well not have been noticed, and in specimens from Wissenbach in the British Museum, Mr. Crick and I discovered a similar striation, though it seemed direct rather than oblique. The former difference is probably due to the English shell being a little flattened out. I therefore have little doubt that they are identical.

*Affinities.*—This is distinguished from *Tentaculites tentacularis*, Phillips, sp., by its very much lower rate of tapering.

*T. subconicus*, Geinitz,<sup>1</sup> is much narrower, increasing at the rate of two in eleven, but Geinitz hesitates whether to regard it as more than a variety. He states<sup>2</sup> that *T. annulatus*, Schlotheim,<sup>3</sup> is very much larger, and that Schlotheim's fig. 8 *a* is Silurian, but fig. 8 *b* is Devonian.

*Orthoceras Ausavense*, Steininger, is considerably larger and more elongate, but is otherwise very similar in general appearance.

*T. durus*, Ludwig,<sup>4</sup> seems narrower and larger.

*T. acuarius*, Richter,<sup>5</sup> as given by Kayser,<sup>6</sup> has fewer annuli, and the striæ are longitudinal, not oblique.

<sup>1</sup> 1853, Geinitz, 'Verst. Grauwack. Saschen,' pt. 2, p. 73, pl. xix, fig. 15.

<sup>2</sup> Ibid., p. 73.

<sup>3</sup> 1820, Schlotheim, 'Petrefact.,' p. 377, pl. xxix, fig. 8 *a*.

<sup>4</sup> 1864, Ludwig, 'Palæontograph,' vol. xi, p. 318, pl. l, figs. 3 *a*, *b*.

<sup>5</sup> 1854, Richter, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. vi, p. 285, pl. iii, figs. 3—9.

<sup>6</sup> 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 112, pl. xxxi, figs. 1—3.

*Sub-genus*—*COLEOLUS*, Hall, 1879.

Shell tubularly conical or slightly curved, very elongate; walls rather thick, smooth interiorly, annulated with transverse or oblique striæ or rings externally.

It is very doubtful whether there is any reason for separating this group from *Tentaculites* proper, on account of its smooth, simple interior, thicker walls, &c.

2. *TENTACULITES* (*COLEOLUS*?) *TENTACULARIS*, Phillips, sp. Plate IV, fig. 15.

1841. *ORTHOCERAS TENTACULARE*, Phillips. Pal. Foss., p. 112, pl. xliii, figs. 210 *a—e*.  
 ? 1845. *TENTACULITES TENUIS*, Keyserling. Wissensch. Beob. Petschora-Land, pp. 272, 273.  
 ? 1850. — *TENUICINCTUS*, F. A. Römer (pars?). Beitr. Harzgeb., pt. 1, p. 28, pl. iv, figs. 19 *a ?*, *b*.  
 ? 1853. — — Sandberger. Verst. Rhein. Nassau, p. 250, pl. xxi, fig. 13.  
 ? 1887. — — Tschernyschew. Mém. Com. Géol., vol. iii, No. 3, p. 42, pl. vii, fig. 14.

*Description*.—Test very elongate, conical, circular in section, increasing at the rate of about 1 : 20, internally smooth, externally banded by very numerous, regular, elevated, rather distant annuli, about five or seven in a space equal to width, and with a few finer irregular striæ. Structure rather thick.

*Size*.—An imperfect specimen is 15 mm. long and 2 mm. in diameter.

*Localities*.—A slab in the Porter Collection contains six imperfect specimens from Pilton. Phillips quotes it from Baggy Point and from Meadfoot (near Torquay).

*Remarks*.—These specimens are evidently identical with Phillips's North Devon shell, though the annuli are generally closer. He regards it as an *Orthoceras*, because he considered that he saw septa in some of the specimens. He remarks, however, "that they are not satisfactory in regard to the siphuncle and septa," and he does not state whether it was in the North or the South Devon specimens that he observed these appearances. I should have very great difficulty in regarding those fossils which I have examined as Cephalopods, both on account of the thickness of their walls and the smooth simple casts of their interior, which show no signs of septa. The lines indicating septa in Phillips's figure might, I think, easily be accounted for by the shrinkage of sediment in a long tube. Septa, however, exist near the apical end of *T. attenuatus*, Hall.<sup>1</sup>

<sup>1</sup> 1889, Nicholson and Lydekker, 'Manual Palæont.,' vol. i, p. 809, fig. 725.

*T. tenuicinctus*, F. A. Römer, has often broader rings, *i. e.* only four in a space equal to the width, but in other respects seems to agree, as far as can be judged by Römer's figure. As given by Sandberger and Tschernyschew, it is so very much smaller than the English fossil that it is *unlikely* to be identical.

*Affinities*.—*T. glaber*, Trautschold,<sup>1</sup> is very similar in shape and arrangement, but the annuli are so fine that the fossil is said to have the appearance of a *Bactrites* or a crinoidal tentacle.

*Orthoceras*, n. sp., Holzapfel,<sup>2</sup> may be compared as being similar in ornament, but considerably larger.

## 2. ORDER—PROSOBRANCHIA, *Milne-Edwards*, 1848.

There seem indications of a considerable number of univalves in the Pilton beds, especially in one or two bands near the base, where some minute species occur in considerable abundance. In the Marwood zone only two species are at present known to have existed.

### I. *Family*—PSEUDOMELANIIDÆ, *Fischer*, 1887.

#### 1. *Genus*—MACROCHILINA, *Bayle*, 1880.

##### 1. MACROCHILINA TURBINEA, n. sp. Plate V, figs. 1, 2.

*Description*.—Shell small, elongate, turbate, of three or four volutions. Spire equal to half the height of the shell, convex, the upper whorls being smaller in proportion than the lower. Suture simple, shallow. Whorls much exposed, very broad, convex, arching out from the upper suture, flattened on the back, and slightly incurving to the lower suture. Shell-structure very thin. Surface smooth.

*Size*.—A defective specimen is 16 mm. long and 8 mm. wide.

*Localities*.—In the Barnstaple Athenæum is a specimen from Kingdon's, Shirwell, and another from Vicarage Well, Pilton.

*Remarks*.—This species, though imperfectly known, appears characterised by its turbate form, resulting from the increasingly disproportionate diminution of its spire, and by its very broad whorls. The surface is shown to be smooth by a small fragment of shell remaining on the figured specimen from Shirwell.

<sup>1</sup> 1881, Trautschold, 'Dev. Foss. Schelong,' p. 5, pl. v, fig. 5.

<sup>2</sup> 1882, Holzapfel, 'Palæontographica,' vol. xxviii, p. 247, pl. xlvii, fig. 5.



*Affinities*.—It appears to be nearest to *M. elevata*, Whidborne,<sup>1</sup> from Lummaton, but to be distinguishable by its still broader whorls, and turbinate instead of conical spire.

Mr. Roberts seems to have been inclined to identify it with *Loxonema linctum*, Phillips, sp.;<sup>2</sup> but it appears separable from that shell by its broader and more exposed whorls, its loftier spire, and its smooth surface.

It is very distinct from all the Carboniferous shells described by de Koninck.

## 2. MACROCHILINA PUSILLA, n. sp. Plate V, fig. 3.

*Description*.—Shell very small, rather elongate, of four or five volutions. Spire conical, elevated, turrited, less than half the height of the shell. Suture rather deep and subacute. Whorls narrow, very much exposed, rapidly increasing, convex on the shoulder, rather flattened on the back, and curving in to the lower suture. Body-whorl large, diffuse, subglobose, rapidly narrowing in front. Surface smooth.

*Size*.—Height 3 mm., width 2 mm.

*Localities*.—There are two specimens from Pilton and one from Frankmarsh in the Porter Collection, and one from Upcott Arch Quarry in Miss Partridge's Collection.

*Remarks*.—It is of course possible that these minute shells may be the fry of a larger species, but I know of none with which there is reason to identify them. It seems to me, therefore, that they must be regarded as a new form.

*Affinities*.—It appears to have a higher spire and less enveloped whorls than *M. imbricata*, Sowerby, sp.;<sup>3</sup> more convex and less enveloped whorls than *M. subimbricata*, d'Orbigny, sp.;<sup>4</sup> and much narrower whorls than any of the other South Devon species.

It seems to have a higher spire than *M. monodontiformis*, de Koninck,<sup>5</sup> and a wider body-whorl than *M. minor*, de Koninck.<sup>6</sup>

<sup>1</sup> 1891, vol. i, p. 170, pl. xvii, figs. 11—12 a.

<sup>2</sup> Ibid., p. 170, pl. xvii, fig. 13.

<sup>3</sup> Ibid., p. 164, pl. xvii, figs. 1—4.

<sup>4</sup> Ibid., p. 166, pl. xvii, figs. 5—7.

<sup>5</sup> 1881, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. vi, pt. 3, p. 28, pl. iii, figs. 32, 33.

<sup>6</sup> Ibid., p. 35, pl. iii, figs. 28, 29.



2. *Genus*—LOXONEMA, *Phillips*, 1841.

## 1. LOXONEMA HALLII, n. sp. Plate V, fig. 8.

*Description*.—Cast small, elongate, tapering, of seven or eight whorls. Spire conical, much larger than the body-whorl. Sutures very slight. Whorls nearly flat and very broad. Apex acute. Surface apparently smooth.

*Size*.—Height about 12 mm.; width about 4 mm.

*Locality*.—One specimen from Vicarage Well, Pilton, is in the Barnstaple Athenæum.

*Remarks*.—This appears to be an almost perfectly conical shell, the sutures being very slightly indented, and the whorls obliquely flattened. Though the only specimen is in a very poor and rather crushed condition, it seems to give sufficient evidence of its distinctness from any other Devonian forms with which I am acquainted.

*Affinities*.—It comes very near in general shape to the Carboniferous *Loxonema leviusculum*, de Koninck,<sup>1</sup> but differs in having considerably broader and fewer whorls, and probably a larger body-whorl. Its mouth is not preserved, so that its genus can be only decided by its general affinity to other species; and as numerous similar shapes are referred by de Koninck to *Loxonema*, I have placed it in that genus.

It bears considerable resemblance to *Macrochilina ejecta*,<sup>2</sup> from South Devon, especially in the breadth and flattening of its whorls, but differs in its more elongate spire.

2. LOXONEMA TROCHLEATUM, *Münster*, sp. Plate V, figs. 4, 4 a, 5, 5 a.

1840. TURRITELLA TROCHLEATA, *Münster*. Beitr., pt. 3, p. 88, pl. xv, fig. 18.

1843. LOXONEMA SUBULATA, *F. A. Römer*. Verst. Harzgeb., p. 31, pl. viii, figs. 12, 12 a.

1853. — — *Sandberger*. Verst. Rhein. Nassau, p. 229, pl. f. xxvi, fig. 10.

*Description*.—Shell very small, many-whorled, slowly increasing, aciculate. Whorls nearly as broad as high, with a narrow, oblique, flat rim under the suture,

<sup>1</sup> 1881, de Koninck, 'Ann. Mus. Roy. H. N. Belg.,' vol. vi, p. 44, pl. iv, figs. 28, 29.

<sup>2</sup> 1891, Whidborne, 'Dev. Fauna,' vol. i, p. 170, pl. xvii, fig. 13.

which is bounded by a blunt angle at the shoulder, the rest of the whorl being gently convex. Surface smooth, shell-structure rather thick.

*Sile.*—An imperfect specimen is 6 mm. long and 2 mm. wide.

*Locality.*—In the Barnstaple Athenæum are two specimens from Kingdon's, Shirwell, and one from Vicarage Well, Pilton.

*Remarks.*—These specimens are portions of an extremely elongate shell, which increases very slowly, the diameter of the highest remaining whorl being more than half that of the fifth below it. As far as can be seen they exactly correspond with the species described by Sandberger, which, as stated by him, is a synonym of *Turritella trochleata*, Münster. The latter shell, he says, is different from *Turbonilla trochleata*, Geinitz,<sup>1</sup> which certainly seems to have narrower and more convex whorls than our specimens.

To Römer's own shell they bear less likeness, as that is described as finely striated on the body-whorl, and has perhaps even broader whorls. As, however, the body-whorls of our specimens seem lost, and the surface of the shell is in rather obscure preservation, and as Sandberger distinctly describes the whorls as smooth, there appears to be no reason to separate them on that account.

A kindred specimen in the Woodwardian Museum from west of Saunton Court is noteworthy, though it is too poor for identification. Three or four whorls are seen, which increase much more rapidly in height than in width, so that the lower whorls are one and a half times as high as wide. Possibly it is only a distorted variety of the present species, but it presents great similarity to species of the genus *Subulites*, to which it may perhaps belong.

*Affinities.*—The very similar specimen figured by Frech<sup>2</sup> appears from his description to be a *Murchisonia*, having a sinus-band.

### 3. LOXONEMA PRISCUM, Münster, sp?

1891. LOXONEMA PRISCUM, *Whidborne*. Dev. Faun., vol. i, p. 181, pl. xviii, figs. 17—19.

*Localities.*—There are several small specimens in the Woodwardian Museum from the west of Saunton Court.

*Remarks.*—These specimens, which are in a very poor state of preservation, seem very similar to the fossils from Lummaton and Wolborough, which I have referred to this species.

*Affinities.*—They differ from the Shirwell specimens referred to *L. trochleatum*

<sup>1</sup> 1853, Geinitz, 'Verst. Grauw. Sachs.,' pt. 2, p. 42, pl. xi, fig. 7.

<sup>2</sup> 1887, Frech, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. xxxix, p. 730, pl. xxviii, fig. 1.

in being much shorter shells with fewer, narrower, and more rapidly increasing whorls.

Their smooth surface at once distinguishes them from *L. Hennahianum*,<sup>1</sup> to which they have been referred, as well as from *Holopella antiqua*, Goldfuss,<sup>2</sup> sp., which I formerly confused with that shell. Since describing certain Lummaton fossils<sup>3</sup> under the name of *H. Hennahiana*, Sowerby, I have seen the type specimen of that species in the Museum of the Geological Society, and find that it is evidently distinct from them. It is very much more coarsely ribbed than they are, and is more nearly akin to *L. nexile*, Phillips. Those Lummaton shells ought therefore to bear the name *Holopella antiqua*, Goldfuss, sp., instead of *H. Hennahiana*, Sow., which must be restricted to the Plymouth species.

#### 4. LOXONEMA ANGLICUM, d'Orbigny. Plate V, fig. 6.

1841. LOXONEMA RUGIFERA, *Phillips*. Pal. Foss., p. 101, pl. xxxviii, fig. 188.  
 1849. — ANGLICA, d'Orbigny. Prodrôme, vol. i, p. 62.  
 1867. — RUGIFERUM, *Trenkner*. Paläont. Novitat., pt. 1, p. 11, pl. i, fig. 19.  
 1884. — — *Clarke*. Neues Jahrb. f. Min., Beil.-Band 3, p. 366, pl. v, figs. 24, 25.  
 1895. — RUGIFERA, *Vénukoff*. Syst. Dev. Chaîne des Mongodjares, p. 153, pl. iii, fig. 12.

*Description*.—Shell large, many-whorled, subulate, very elongate, with apparently rather undulating sides to the spire. Apex aciculate. Spire consisting of ten or eleven very broad whorls, which are higher than the width of the shell near the apex, and gradually diminish in ratio, so that the height of the tenth whorl is about two-thirds of its width. Suture simple, shallow, obtuse. Whorls sloping from the suture in a sigmoid curve, the upper part being slightly and obliquely concave, and the lower part wide and convex; ornamented with about twelve very large, prominent, transverse, rounded ribs, which are largest in the central parts of the whorl, and are rather oblique and slightly sigmoid, and so arranged that they frequently form continuous ribs down the spire. "Mouth roundish."

*Size*.—A specimen in the Museum of Practical Geology measures 45 mm. high by 11 mm. wide.

*Localities*.—There are four specimens from Branton Down in the Museum of Practical Geology, and one from Frankmarsh in Mr. Hamling's Collection. A very poor cast from Kingdon's in the Barnstaple Athenæum appears to belong to this species.

<sup>1</sup> 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol v, pt. 3, pl. lvii, fig. 22.

<sup>2</sup> 1844, Goldfuss, 'Petref. Germ.,' vol. 3, p. 110, pl. cxvii, fig. 14.

<sup>3</sup> 1891, Whidborne, 'Dev. Fauna,' vol. i, p. 228, pl. xviii, figs. 16, 16 a.



*Remarks.*—This beautiful species is well described and represented by Phillips in the 'Pal. Foss.,' but it appears to be distinct from the Yorkshire *L. rugiferum* (Ph.),<sup>1</sup> with which he identifies it. It is distinguished by the fact that the ribs are continuous over the whole surface in the adult shell, as well as in the young form. This distinction is observable even in Phillips's own descriptions of his two shells. The evanescence of the upper part of the ribs in adult shells in the Carboniferous species is still more clearly seen in de Koninck's figures,<sup>2</sup> who separates the Devonian form from it on the authority of d'Orbigny under the name of *L. anglicum*. On the other hand, in all the Devonshire specimens of *L. anglicum*, even in the largest which I have seen, the continuity of the ribs is clear; and these ribs also seem slighter, more continuously uniform in size, and rather more flexuous. The same characters are shown by both Clarke's and Trenkner's figures of the German Devonian shell.

At the same time the two forms have many characters in common, and it is quite possible that the examination of a larger series of examples than we have at present might break down the line of distinction between them.

*Affinities.*—*L. angulosum*, F. A. Römer,<sup>3</sup> is a shorter, fewer-whorled shell, with more arching ribs.

*Holopella moniliformis*, F. A. Römer,<sup>4</sup> differs in having its ribs twice as numerous, and twice as fine.

## II. *Family*—NATICIDÆ, *Forbes*, 1838.

### 1. *Genus*—NATICOPSIS, *M'Coy*, 1844.

#### 1. NATICOPSIS HALLII, n. sp. Plate V, figs. 11, 12, 13?

*Description.*—Shell rather small, subglobose, rather oblique. Spire low, turbiniform, consisting of between three and four rapidly increasing convex volutions, which are less than half exposed. Sutures shallow, obtuse. Body-whorl more than two-thirds the total height of shell, voluminous, convex. Mouth pear-shaped, longer than wide, entire, acute behind. Inner lip sigmoidal, somewhat produced below, where it forms a spurious columella, and covered with a spreading callosity. Umbilicus apparently closed. Surface smooth.

<sup>1</sup> 1838, "*Melania rugifera*," Phillips, 'Geol. Yorks.,' vol. ii, p. 229, pl. xvi, fig. 26.

<sup>2</sup> 1881, de Koninck, 'Ann. Musée Roy. d'Hist. Nat. Belg.,' vol. vi, p. 59, pl. vi, figs. 12, 13.

<sup>3</sup> 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. 1, p. 3, pl. i, fig. 5.

<sup>4</sup> 1866, *ibid.*, pt. v, p. 8, pl. xxxiv, figs. 5a, b.



*Size*.—Two specimens measure respectively 14 mm. high by 12 mm. wide, and 18 mm. high by 16 mm. wide.

*Localities*.—In the Barnstaple Athenæum are two casts and one mould from Sloly, and in the Museum of Practical Geology, seven casts from the Marwood beds, and four from "Pilton beds, Croyde Bay," besides another poor specimen from Croyde, which appears to have come from a higher horizon. A minute cast (fig. 13) from the Cucullæa beds of Baggy Point, in Mr. Hamling's Collection, which has a very low spire, seems to be the young form of this species.

*Remarks*.—These fossils have been variously referred to *Natica meridionalis*, *Macrocheilus imbricatum*, and *Pleurotomaria*, but they certainly have nothing to do with either. With two exceptions they have a red ferruginous matrix, indicating that they came from the top of the Sloly beds. The surface is seen from the mould to be distinctly smooth. The shape of the mouth is well shown in some specimens, the outer lip curving regularly to the front, until it meets the inner lip, where it curls round, forming the free margin of a long oblique cylinder of shell, which is a kind of spurious columella. The height of the spire is rather variable, and probably increases with age. This species is named after Townshend M. Hall, Esq., F.G.S., who made the Collection now in the Barnstaple Athenæum.

*Affinities*.—It is easily distinguished from *N. meridionalis*, Phillips,<sup>1</sup> by its smoothness, and its greater size and shortness.

*Natica striolata*, F. A. Römer,<sup>2</sup> differs in being finely striated, and in having a rather higher spire.

*Natica purpura*, F. A. Römer,<sup>3</sup> is much more elongate, and has a much higher spire.

*Naticopsis elegantula*, Ehlert and Davoust<sup>4</sup> (which appears to agree generically), is very similar to the young form of our shell, but seems distinguished by having transverse and also fine longitudinal striæ.

## 2. Genus—NATICA, Adanson, 1757.

### 1. NATICA? MERIDIONALIS, Phillips. Plate V, fig. 14.

1841. NATICA MERIDIONALIS, Phillips. Pal. Foss., pl. xxxvi, fig. 173.

*Description*.—"Shell small, with equidistant undulations, which are most prominent on the upper part of the whorl, and pass thence in a directly longitudinal direction" (Phillips).

<sup>1</sup> 1841, Phillips, 'Pal. Foss.,' p. 94, pl. xxxvi, fig. 173.

<sup>2</sup> 1850, F. A. Römer, 'Beitr. Harz,' pt. 1, p. 33, pl. v, fig. 7.

<sup>3</sup> Ibid., pt. 1, p. 34, pl. v, fig. 8.

<sup>4</sup> 1880, Ehlert and Davoust, 'Bull. Soc. Géol. Fr.,' ser. 3, vol. vii, p. 712, pl. xv, figs. 3—3 c.

*Size*.—Height 2 mm., width 1.5 mm.

*Localities*.—Baggy (*vide* Phillips). One or two small casts from Ironpost, near Dulverton, in my collection, appear to belong to this species.

*Remarks*.—I have not met with any undoubted specimens of this shell, but the above-mentioned casts probably belong to it. They are globose shells with half-exposed, quickly-increasing whorls, which (in the cast) are convex on the shoulder and nearly flat on the broad back. They agree with Phillips's figure in dimensions, except that perhaps they are slightly wider.

*Affinities*.—From *Naticopsis Hallii* they differ in being much smaller, less oblique, and more elongate and turrited.

### III. *Family*.—CAPULIDÆ, *Fleming*, 1828.

#### 1. *Genus*.—CAPULUS, *Montfort*, 1810.

##### 1. CAPULUS ROSTRATUS, *Trenkner*? Plate V, fig. 15? 16.

? 1867. CAPULUS ROSTRATUS, *Trenkner*. Paläont. Novit., pt. 1, p. 12, pl. i, fig. 22.

1891. — — ? *Whidborne*. Devon. Faun., vol. i, p. 207, pl. xx, figs. 6—8.

*Locality*.—One or perhaps two small specimens are in the Porter Collection from Pilton.

*Remarks*.—Mr. Porter's specimen undoubtedly agrees, I think, with Wolborough and Lummaton fossils referred by me to this somewhat doubtful species. The body-whorl is deeply concave below and very much flattened. The apex would seem to be much closer to the plane of the mouth than it is in the South Devon specimens.

A very similar specimen was found by Dr. Hicks and myself at Freshwater West, Pembrokeshire.

##### 2. CAPULUS TERMINALIS, *Whidborne*. Plate V, figs. 17, 17 a.

? 1885. CAPULUS DORMITANS, *Maurer*. Abhandl. Grossh. Hessisch. Geol. Landes., vol. i, pt. 2, p. 239, pl. x, figs. 14, 14 a.

? 1885. — HAINENSIS, *Maurer*. Ibid., p. 239, pl. x, figs. 16—20.

1890. — TERMINALIS, *Whidborne*. Devon. Fauna, vol. i, p. 211, pl. xx, figs. 16, 16 a.

*Locality*.—There are two specimens in the Porter Collection from Pilton.

*Remarks*.—One of Mr. Porter's specimens is a fine though slightly distorted cast, and appears accurately to agree with the South Devon form. The second is a mould, and is consequently doubtful, as the shape of the upper part of the whorl is hidden.

The English fossils closely resemble and are midway between Maurer's two species, *C. dormitans* and *C. Hainensis*. These two species seem to differ only in the length of the body-whorl, and the latter of them itself is seen to vary considerably in that particular. If the three forms are identical, *C. dormitans* would be its rightful name. It may, perhaps, be well for the present to leave them unblended, as in the upper part of the inner side of the English specimens is a strong longitudinal fold not seen in the German specimens, and we have not at present sufficient material to show whether this is an accidental or permanent character.

### 3. CAPULUS COMPRESSUS, *Goldfuss*, sp. Plate V, figs. 18, 18 a.

1891. CAPULUS COMPRESSUS, *Whidborne*. Dev. Faun., vol. i, p. 209, pl. xx, figs. 9—11.

1895. PLATYCERAS COMPRESSUM, *Kayser*. Ann. Soc. Géol. Belg., vol. xxii, p. 184, pl. iv, figs. 1—3.

1895. — — — *Holzapfel*. Abhandl. k. Preuss. Geol. Landes., n.s. pt. 16, p. 176, pl. xi, figs. 5, 6, 9; pl. xiv, figs. 8—11; and pl. xv, figs. 1—3.

*Size*.—Height 8 mm., width 17 mm., depth 17 mm.

*Localities*.—In the Barnstaple Athenæum are three casts from Top Orchard, Croyde Bay, and Pilton respectively.

*Remarks*.—These specimens are not very clear, being too much crushed and obscured by matrix to be easily identified. In its present condition the best preserved specimen so closely resembles *C. compressus*, especially as figured by Kayser from Belgium, that it seems most probable that they are identical.

*Affinities*.—From South Devon specimens of *C. rostratus*, Trenkner, it differs by its less flatness, by the concavity of its lower side, and by indications of longitudinal folds near the mouth. It is quite possible that, as Holzapfel asserts, *C. rostratus* may prove to be only a variety of *C. compressus*; but I can by no means follow him in uniting such totally distinct shells as *Diaphorostoma* (= *Platyostoma*) ? *sigmoidale*, &c., with the latter species.



*C. Zinckeni*, F. A. Römer,<sup>1</sup> as given by Barrois,<sup>2</sup> has a less incurved and rounded apex, and a much more rapidly increasing whorl.

## 2. *Sub-genus*—ORTHONYCHIA, Hall, 1843.

### 1. ORTHONYCHIA ROTUNDA, n. sp. Plate V, figs. 19, 19 a.

*Description*.—Shell rather large, elevated, campanulate, not involute. Apical extremity small, bent forward; the perpendicular from the apex to the plane of the mouth falling within the aperture at one-third of the diameter from its front or inner side. Whorl very rapidly expanding, indented by four indistinct shallow depressions, which run from near the apex to the corners of the mouth. Mouth very wide, expanding, sub-quadrate, considerably wider than long, with a rather undulating margin, which is lobed by the indistinct concavities at the corners. Surface apparently rather irregular, and covered with coarse undulating growth-lines.

*Size*.—Height 24 mm.; width across mouth 26 mm., from mouth to apex 15 mm.

*Locality*.—A single specimen from Pilton is in the Porter Collection.

*Remarks*.—This fossil, while approaching *Orthonychia quadrangularis*, mihi,<sup>3</sup> from South Devon, appears to differ specifically by having a more central and recurved apex, a more oblique inner side, a rougher surface marked with undulating growth-lines, and a less quadrate mouth, which is undulated by several concavities round the margins. The apex itself is defective both in the mould and cast of our specimen.

*Affinities*.—It approaches *Platyceras dubium*, Barrois,<sup>4</sup> but seems to differ in being less transverse and less botryoidal, and in having a recurved apex.

### 2. ORTHONYCHIA ACUTA, F. A. Römer, sp. Plate V, figs. 20, 21; and Plate VI, figs. 1, 1 a, 2, 2 a.

1855. ACROCULIA ACUTA, F. A. Römer. Beitr. Harzgeb., pt. 3, p. 6, pl. ii, fig. 11.

1855. — BISCHOFII, F. A. Römer. Ibid., pt. 3, p. 6, pl. ii, fig. 10.

<sup>1</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 17, pl. vii, fig. 4.

<sup>2</sup> 1889, Barrois, 'Mém. Soc. Géol. Nord,' vol. iii, p. 197, pl. xiii, figs. 6—6 c.

<sup>3</sup> 1891, Whidborne, 'Devon. Faun.,' vol. i, p. 223, pl. xxi, figs. 8—8 b.

<sup>4</sup> 1889, Barrois, 'Mém. Soc. Géol. Nord,' vol. iii, p. 191, pl. xiii, figs. 1 a, b.



1858. *CAPULUS ACUTUS*, *Giebel*. Sil. Faun. Unterharz., p. 18, pl. iii, figs. 14, 17, 18.
1858. — *BISCHOFII*, *Giebel*. Ibid., p. 19, pl. iii, figs. 1, 3, 13.
1858. — *ACUTISSIMUS*, *Giebel*. Ibid., p. 19, pl. iii, fig. 9.
- ? 1858. — *SELCANUS*, *Giebel*. Ibid., p. 20, pl. iii, fig. 8.
1861. *PLATYCERAS CONICUM*, *Hall*. Desc. New Species Fos., p. 3.
1861. — *QUINCYENSIS*, *McChesney*. Desc. New Palæoz. Foss., p. 90.
1865. — — — Ibid., Illust., pl. vi, figs. 6 *a*, *b*.
1867. — *QUINCYENSE*, *McChesney*. Trans. Chicago Acad. Sci., vol. i, p. 49, pl. vi, fig. 6.
1868. — (*ORTHONYCHIA*) *QUINCYENSE*, *Meek and Worthen*. Geol. Surv. Illinois, vol. iii, p. 510, pl. xv, figs. 5 *a*, *b*.
- ? 1868. — — *SUBPLICATUM*, *Meek and Worthen*. Ibid., p. 457, pl. xiv, figs. 4 *a*—*c*.
- ? 1868. *CAPULUS CONICUS*, *Trenkner*. Palæont. Novitat., pt. 2, p. 21, pl. vii, fig. 14.
1878. — *HERCYNICUS*, *Kayser*. Abhandl. Geol. Specialk. Preuss, Band 2, pt. 4, p. 89, pl. xiv, figs. 1—14; and pl. xv, figs. 10—11 *b*.
1879. *PLATYCERAS (ORTHONYCHIA) CONICUM*, *Hall*. Pal. N. Y., vol. v, pt. 2, p. 3, pl. i, figs. 13—23.
- ? 1885. — *SELCANUS*?, *Maurer*. Abhandl. Grossh. Hessisch. Geol. Landes., vol. i, pt. 2, p. 242, pl. x, figs. 23, 24.
1889. *PLATYCERAS ACUTUM*, *Barrois*. Mém. Soc. Géol. Nord., vol. iii, p. 198, pl. xiii, fig. 7.
1889. — *ACUTISSIMUM*, *Barrois*. Ibid., p. 199, pl. xiii, fig. 8.
1889. — *HERCYNICUM*, *Barrois*. Ibid., p. 189.
- ? 1889. — *SELCANUM*, *Barrois*. Ibid., p. 190, pl. xii, fig. 7.
- ? 1889. — *DUBIUM*, *Barrois*. Ibid., p. 191, pl. xiii, fig. 1.
1893. — *CULTELLUS*, *Tschernyschew*. Mém. Com. Géol., vol. iv, No. 3, p. 157, pl. i, fig. 27.

*Description*.—Shell elongate, not involute, very variable. Apex blunt, vertical, situate somewhat in front of the perpendicular from the centre of the plane of the mouth. Whorl more or less conical or fusiform, increasing with variable rapidity, and generally bearing several concavities and convexities, which radiate from the apex, and which render the oral margins irregularly lobate. Mouth large, sub-oval. Surface apparently marked by indistinct growth-lines.

*Size*.—Height 12 mm., width 12 mm.

*Localities*.—There is a specimen from Sowden, near Barnstaple, and one from Top Orchard, in the Barnstaple Athenæum; another from Top Orchard in the Woodwardian Museum; and three, respectively from Pilton, Fremington, and Marwood Parish, in the Porter Collection.

*Remarks*.—The above specimens vary very greatly in shape. No two of them

are alike, and the great difference in apical height may be seen by comparing the two first figures on Pl. VI. No doubt this is partly due to pressure during fossilization, but the amount of natural variation was evidently very great. Nevertheless, there do not appear to be any definite characters by which any of them might be specifically distinguished from the rest, and there seems every reason to suppose that they all belong to a single very variable species.

This view is borne out by a comparison with the foreign forms described by F. A. Römer, with which our English specimens evidently agree. They are shown by Kayser to form part of an extremely variable species, to which he gives the name *C. hercynicus*, but which, as it appears to me, the laws of nomenclature oblige us to call either *C. Bischoffi* or *C. acutus*. The limits which Kayser assigns to his species are still wider than those shown by our Pilton specimens. There is no English evidence of the elongate *C. acutissimus* or the smooth *C. selcanus* which he includes among its varieties. Even, however, excluding the two latter forms, the variation of the German shell is fully as great as ours.

Barrois, it is true, re-divides Kayser's species, but he intimates that he does so simply on artificial grounds, and it seems possible that some of his other forms, besides those enumerated above, may also belong to it.

Tschernyschew's *P. cultellus* is a flattened form almost exactly like the specimen here figured on Pl. V, fig. 20, and cannot possibly be specifically distinct from that shell.

*C. conicus*, Hall, seems exactly to correspond.

The American Carboniferous form *Platyceras quincyense*, McChesney, appears to have its base more oblique, so that the front margin seems perpendicular to it. This, if not a mere accident, is possibly not more than a varietal difference. It seems to fall well within the limits of the present species, but its apex is unknown.

One of Mr. Porter's Pilton specimens is interesting from the fact that it is attached to, and seems totally to envelope, a specimen of *Actinocrinus Porteri*.

*Affinities*.—*Platyceras Lovieri*, de Verneuil,<sup>1</sup> is distinguished by its whorl being much more incurved and considerably overhanging the inner margin of the mouth.

*Platyceras dentalium*, Hall,<sup>2</sup> differs by having the longitudinal ribs and furrows twisted instead of straight.

*Capulus quadratus*, Maurer,<sup>3</sup> seems distinguished by its quadrate section, its sharp apex, and its perpendicular inner side.

<sup>1</sup> 1850, de Verneuil, 'Bull. Soc. Géol. Fr.,' ser. 2, vol. vii, p. 779; and 1881, Ehlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 14, pl. ii, figs. 1 *a*—*d*.

<sup>2</sup> 1861, Hall, 'Desc. New Species,' p. 1; and 1879, Hall, 'Pal. N. Y.,' vol. v, pt. 2, p. 2, pl. i, figs. 3—8; and 1881, Ehlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 15, pl. ii, figs. 2 *a*—*c*.

<sup>3</sup> 1885, Maurer, 'Abhandl. Grossh. Hessisch. Geol. Landes.,' vol. i, pt. 2, p. 243, pl. x, figs. 26—28.

The Carboniferous *C. rectus*, de Ryckholt,<sup>1</sup> approaches so close as to show no points of difference in the original figure; but, as given by de Koninck,<sup>2</sup> who unites with it *C. corporatus*, de Ryckholt,<sup>3</sup> it is distinguished by having a sharper, more regular and curved apex, and a convex back. De Koninck<sup>3</sup> also doubtfully joins to it *C. subplicatum*, Meek and Worthen, which seems indistinguishable from low forms of the present shell.

IV. *Family*—SCALARIIDÆ, *Broderip*, 1839.

1. *Genus*—HOLOPELLA, *M'Coy*, 1852.

1. HOLOPELLA TENUISULCATA, *Sandberger*. Plate V, fig. 7; and Plate VI, figs. 3, 3 a.

1891. HOLOPELLA TENUISULCATA, *Whidborne*. Dev. Fauna, vol. i, p. 255, pl. xvii, fig. 20; and pl. xviii, fig. 10.

*Size*.—Length 24 mm., width 10 mm.

*Localities*.—Three specimens from Kingdon's, Shirwell, are in the Barnstaple Athenæum.

*Remarks*.—These fossils, though almost entirely in the form of casts, seem undoubtedly to correspond with the South Devon shell. A small portion of the surface remaining on one of them shows the oblique transverse striæ characteristic of the species.

2. *Genus*—ACLISINA, *de Koninck*, 1881.

This genus was formed by de Koninck for elongate shells with convex spirally striated walls; oval mouth; smooth, entire, and unexpanding outer lip; slightly thickened and unbent columella; and imperforate axis.

He distinguishes it from *Murchisonia* by the absence of a sinus-band; from *Loxonema* by its spiral striæ; from *Turritella* by its more convex whorls and deeper suture; and from *Aclis* by its simple columella.

<sup>1</sup> 1867, de Ryckholt, 'Mélange Pal.,' pt. 1, p. 36, pl. i, figs. 5, 6.

<sup>2</sup> 1883, de Koninck, 'Ann. Mus. Roy. H. S. Belg.,' vol. viii, pt. 4, p. 171, pl. xlvi, figs. 14—16, 23, 24.

<sup>3</sup> 1867, de Ryckholt, 'Mélange Pal.,' pt. i, p. 38, pl. i, figs. 11, 12.



1. *ACLISINA LONGISSIMA*, n. sp. Plate V, fig. 10.

*Description*.—Shell minute, aciculate, of very numerous whorls. Whorls nearly evenly convex, very narrow, very slowly increasing, much exposed. Sutures simple, rather deep. Ornament consisting of six fine, acute, elevated, distant, spiral threads, placed at equal distances on the whorl, and separated by wide concave interspaces.

*Size*.—A fragment with seven whorls is about 3 mm. long.

*Locality*.—There is a specimen showing seven whorls in the Porter Collection from Pilton.

*Remarks*.—This tiny fossil differs from M'Coy's description of *Loxonema polygyratum*,<sup>1</sup> from the Yellow Sandstone Group of the Irish Carboniferous, by having six ridges instead of five, by having narrow whorls, and by being still more aciculate. De Koninck regards that species as belonging to *Aclisina*, and not to *Murchisonia*.

*Affinities*.—*Aclisina multicristata*, Ehlert,<sup>2</sup> is distinguished by having decidedly more numerous spiral ridges.

From *Murchisonia similis*, Trenkner,<sup>3</sup> it differs in being much more aciculate and having more numerous ridges.

## V. Family—SOLARIIDÆ, Chenu, 1859.

## 1. Genus—EUOMPHALUS, Sowerby, 1814.

1. *EUOMPHALUS VERMIS*, n. sp. Plate VI, figs. 4, 4 a.

- |       |                             |                         |   |
|-------|-----------------------------|-------------------------|---|
| 1841. | <i>EUOMPHALUS SERPENS</i> , | <i>Phillips</i> (pars). | Pal. Foss., p. 94, pl. xxxvi, figs. 172 c—e (only).   |
| 1844. | —                           | —                       | <i>M'Coy</i> . Synopsis Carb. Foss. Ireland, p. 37.   |
| 1853. | —                           | —                       | <i>Geinitz</i> . Verst. Grauw. Sachsen, pt. 2, p. 43. |
| 1890. | —                           | sp.,                    | <i>Whidborne</i> . Dev. Fauna, vol. i, p. 243.        |

*Description*.—Shell minute, nearly discoid. Spire of about four whorls, very slightly elevated above the body-whorl. Whorls slowly increasing, nearly circular

<sup>1</sup> 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 30, pl. iii, fig. 1.

<sup>2</sup> 1887, Ehlert, 'Bull. Soc. Étud. Sci. Angers,' 1887, p. 10, pl. viii, figs. 4, 4 a.

<sup>3</sup> 1867, Trenkner, 'Paläont. Novitat.,' pt. 1, p. 10, pl. i, fig. 17.



in section, very convex at the shoulder, gently convex on the back. Sutures deep not wide. Umbilicus very large, and moderately shallow.

*Size*.—Approximate measurements: width 6 mm., height 2.5 mm.

*Localities*.—In the Barnstaple Museum are four specimens from Frankmarsh, one from Kingdon's, Shirwell, and two from Vicarage Well. In the Porter Collection are several specimens from Pilton; in the Museum of Practical Geology one from Brushford; in my Collection one from Frankmarsh; and in Mr. Hamling's Collection, one from the Kiln, Croyde Bay.

*Remarks*.—These shells evidently belong to one of the species included by Phillips under the name *Eu. serpens*, viz. that represented by his figures 172 *c, d, e*. They are perfectly distinct from the much larger species which is common in South Devon, and which is, as I believe, generally regarded as *Eu. serpens*, although Phillips's description had evidently chief reference to the present shell. To that larger species I have, therefore, proposed to restrict Phillips's name; and consequently it is necessary to find some other term for the Pilton form.

This species is distinguished by its uniformly small size, by its spire being definitely, though slightly, elevated above the body-whorl, and by the section of its whorls being almost subangular, and as long or longer than wide. It shows very little variation in size or general shape. It is decidedly gregarious; upon one small slab I have counted seven specimens. But, though evidently very common, I have not been fortunate in obtaining good specimens for figuring, and the one which I have had drawn is a small imperfect cast, not giving specific characters as definitely as could be wished.

*Affinities*.—It differs from all the South Devon forms in other points beside size. Its spire is more elevated than that of *Philoæene lævis*, and less so than that of *Eu. Dionysii*.

## 2. EUOMPHALUS, sp.

*Remarks*.—In the Barnstaple Athenæum is a large specimen about 15 mm. in diameter from Vicarage Well, Pilton, which is too imperfect for specific determination, but appears to be quite distinct from the small species common in these beds. Only three fourths of the outer whorl remain. It appears to be discoidal in shape, to have a sunken spire, and to be perfectly circular in the section of the whorls.

## 2. Genus—RHAPHISTOMA, Hall, 1847.

These are small low shells, with a rather small umbilicus, which often bears a small marginal keel. The mouth is sub-trigonal. The whorls bear a narrow band produced by a sinuosity in the aperture. The surface shows growth-lines or fine crenulations at the suture. It occurs in the Lower Silurian and the Carboniferous, and de Koninck remarks on its supposed absence from Upper Silurian and Devonian rocks.

It has generally been regarded as belonging to the *Pleurotomariidæ*; but de Koninck, and perhaps Hall, are inclined to class it with the *Solariidæ*. Possibly it really goes to show the relationship between these two families.

Fischer<sup>1</sup> regards it as synonymous with *Scalites*, Conrad, 1842.

## 1. RHAPHISTOMA JUNIUS, de Koninck. Plate VI, figs. 5—7.

- ? 1841. PLEUROTOMARIA EXPANSA, Phillips. Pal. Foss. (not Geol. Yorks.), p. 97,  
pl. xxxvii, fig. 179.  
1843. EUOMPHALUS RADIANS, de Koninck (pars). Desc. Anim. Foss. Carb. Belg.,  
p. 442.  
1854. — — Morris. Catal., p. 248.  
1876. — — Armstrong, Young, and Robertson. Catal. West Scot.  
Foss., p. 56.  
1881. RHAPHISTOMA JUNIOR, de Koninck. Ann. Mus. Roy. H. N. Belg., vol. vi,  
p. 135, pl. xii, figs. 15—17.

*Description.*—Shell very small, sub-conical, but so much depressed as to be nearly discoidal. Spire consisting of about five rather slowly increasing volutions, much enveloped, the lower walls covering nearly half of the upper half of the whorl above. Apex elevated, sharp. Suture slight, facing upwards. Whorls, in section, much wider than high; in outline, turning suddenly outward from the suture and spreading out obliquely and almost flatly to the centre of the back, where they curve round so suddenly as almost to form a blunt rounded angle, and then proceed with a slight convex curvature to the umbilicus. Ornament consisting of a row of strong, short, transverse ridges, close to the suture, which vanish immediately; the rest of the surface showing no ornament except occasionally very slight and indistinct continuations of some of the striæ of the sutural crown, which arch backwards, and then perhaps turn suddenly forwards just above the angle of the back. Umbilicus small, bordered by a small sunken keel.

*Size.*—Height 4 mm., width 7 mm.

*Localities.*—A specimen from Pilton is in the Porter Collection; three others

<sup>1</sup> 1887, Fischer, 'Manual Conchyl.,' p. 851.

from the west of Saunton Court in the Woodwardian Museum; one from Ironport in my Collection; and one from Kingdon's, Shirwell, in the Barnstaple Athenæum.

*Remarks.*—This little species so exactly agrees with the Carboniferous shell from Belgium, Scotland, and the Isle of Man, described by de Koninck as *Rhaphistoma junius*, that there can be no doubt of their identity. The agreement extends both to shape and markings, umbilicus and umbilical keel. Almost the only difference is that our shells are decidedly smaller, and that de Koninck does not notice the downward continuation of the sutural corona, which is very obscurely observable in one only of our specimens. De Koninck also mentions a depression like a sinus-band, which, however, he regards, not as a true sinus-band, but as a band similar to that seen in some forms of *Euomphalus*, in the neighbourhood of which he therefore places the genus. In our shells this character cannot be distinctly observed.

This species seems to bear very much likeness to the *Pleurotomaria expansa*, Phillips, of the 'Pal. Foss.,' and it is most probable that Phillips's figure represents a specimen of it. That specimen I have not been able to find. In its figure there are indications of a ribbed sinus-band, which certainly does not exist in our present species. On comparing, however, this figure with his description (which is quoted from the description of *Pl. expansa* in the 'Geol. Yorks.') it seems most likely that this appearance in the figure was due to a confusion with the adjoining matrix. At all events, it is pretty clear that the shell he described from Devonshire is quite distinct from the true *Pl. expansa*, Phillips, of Yorkshire, which is clearly a *Pleurotomaria*, is both spirally and obliquely striated, and has no signs of any sutural crown.

Whether *Pl. gracilis*, Phillips, is more than a variety of this species is questionable. Our specimens seem intermediate between Phillips's figures of his two species, but I have been unable to find the types of either, and the data given by him are too meagre for a satisfactory conclusion. If, however, the species which I have described from Lummaton is really identical with Phillips's *Pl. gracilis*, then that shell is certainly distinct from the present, and differs from it by having a more distinct and elevated sinus-band.

*Affinities.*—*Natica discus*, F. A. Römer,<sup>1</sup> is very similar in shape, but is microscopically striated. It perhaps belongs to the same genus, but is so much larger that it is probably a distinct species.

*Trochus oxygonus*, F. A. Römer,<sup>2</sup> has a much sharper basal angle, and perhaps a slightly lower spire.

The flat variety of *Pleurotomaria crenatostriata*, Sandberger,<sup>3</sup> is very similar,

<sup>1</sup> 1852, F. A. Römer, 'Beitr. Harzgeb.,' pt. 2, p. 88, pl. xiii, figs. 11 *a, b, c*.

<sup>2</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 29, pl. viii, fig. 5.

<sup>3</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 188, pl. xxiii, figs. 2—2 *d*.



differing in having the ornament continued all over the whorls, and in having a very definite sinus-band, bounded by threads. The longer variety figured by Sandberger is a totally different shell from ours.

VI. *Family*—PLEUROTOMARIIDÆ, *d'Orbigny*, 1842.

1. *Genus*—PLEUROTOMARIA, *DeFrance*, 1826.

1. PLEUROTOMARIA GRACILIS, *Phillips*.

1892. PLEUROTOMARIA GRACILIS, *Whidborne*. Dev. Fauna, vol. i, p. 303, pl. xxviii, fig. 18.

*Remarks*.—I have found no specimens referable to this species in the Pilton Beds, but Phillips quotes it from Brushford and Baggy Point. His figure shows a distinct sinus-band, and if that is correct it is certainly distinct from *Rhaphistoma junius*, which approaches it in general shape.

2. PLEUROTOMARIA HAMLINGII, n. sp. Plate VI, figs. 9, 9 a.

1841. PLEUROTOMARIA ASPERA, *Phillips* (pars) (not *Sowerby*). Pal. Foss., p. 96, pl. xxxvii, figs. 177 a, b (only).

1889. — DISTINGUENDA, *Whidborne*. Geol. Mag., dec. 3, vol. vi, p. 30.

1892. — — — — — Dev. Fauna, vol. i, p. 290.

*Description*.—Shell small, trochiform, turritid, of equal height and width. Spire elevated, rather slowly increasing, consisting of at least four whorls. Suture obtuse. Whorls narrow, sloping out from the suture in a concave curve to the shoulder, where they suddenly turn through a blunt angle, and then proceed perpendicularly downwards for about the same distance to the lower suture. Sinus-band situate on the shoulder, and consisting of an excavate groove, which is bounded above and below by a thread-like ridge, and has a row of small beads or nodules along its centre. Ornament consisting of (1) a row of small nodules, halfway between the suture and the sinus-band, and a second row of still smaller nodules halfway between this first row and the sinus-band; (2) two equidistant rows of small nodules, the upper row of which is the smallest, situate upon the lower or perpendicular part of the whorl; and (3) minute, transverse elevated threads, which arch gently backwards on the upper part of the whorl, and,



recurving in the sinus-band, become straight and perpendicular across the lower part of the whorl. Cast of shell showing signs of a deep sinus at the mouth.

*Size*.—Height 10 mm., width 10 mm.

*Localities*.—There are five specimens (including a very doubtful cast) in the Barnstaple Athenæum, from Kingdon's, Shirwell; two doubtful casts in the Porter Collection, from Pilton; one in the Woodwardian Museum from Barnstaple; and a large cast in the Museum of Practical Geology from Braunton Down.

*Remarks*.—I have long believed that the shells figured by Phillips as *Pl. aspera*, Sowerby, included two species, and in 1889 I suggested the name *Pl. distinguenda* for those, which specifically differed from Sowerby's type in the Woodwardian Museum. It appears, however, that Tawney in 1873 pre-occupied that name for an Oolitic species, and therefore it requires to be changed.

With this form, as figured by Phillips, these North Devon fossils closely agree, and I believe them to belong to a well-marked species. Our described specimen retains the upper whorls in a beautiful state of preservation, but its body-whorl is defective. It is distinguished from *Pl. aspera* by the spire being more angular or step-shaped, and by the sinus-band being at the shoulder instead of near the lower suture.

M'Coy<sup>1</sup> unites *Pl. aspera* to *Pl. interstitialis*, Phillips.<sup>2</sup> I have compared specimens of the latter with the present shell, and believe them to be quite different. In *Pl. interstitialis* the whorls are more rounded, the spiral marks are more numerous and different, and there are no nodules in the sinus-band. From the true *P. aspera* it is still further removed, though in a different direction.

### 3. PLEUROTOMARIA (GYROMA) ASPERA, Sowerby. Plate VI, figs. 10—13.

1840.	PLEUROTOMARIA ASPERA, Sowerby.	Geol. Trans., ser. 2, vol. v, pt. 3, pl. liv, fig. 16.
1841.	— — Phillips (pars).	Pal. Foss., p. 96, pl. xxxvii. figs. 177 <i>c</i> and <i>d</i> , and 177* ? (only)
1852.	— INTERSTRIALIS, M'Coy (pars).	Brit. Pal. Foss., p. 398.
?? 1852.	— { MINUTA, } F. A. Römer.	Beitr. Harzgeb., pt. 2, p. 81, pl. xii, figs. 17 <i>a, b</i> .
1893.	— { MINIMA, } ASPERA, Collins.	Trans. Roy. Geol. Soc. Cornwall, vol. xi, p. 42.

*Description*.—Shell moderately elevated, conical, of almost equal height and width. Apex blunt. Suture rather broad and shallow. Whorls convex, wider than high in section, sloping regularly from the suture in a gentle, convex, oblique

<sup>1</sup> 1855, M'Coy, 'Brit. Pal. Foss.,' p. 398.

<sup>2</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 227, pl. xv, figs. 10, 10 *a*.

curve over the shoulder, and becoming slightly concave or sigmoidal at the centre and widest part of the whorl, at which is situated a very elevated rounded sinus-band, and below which the outline of the body-whorl passes round with a circular curvature to the umbilicus. Umbilicus wide and deep. Ornament, above the sinus-band, consisting of three or four equidistant, very narrow, distant, spiral threads, between which alternate similar finer threads, crossed by slightly oblique and sigmoidal, similar and similarly-placed transverse threads, so as to form hollow squares, which become rather nodose at the corners by the intersection of the threads. Sinus-band situated close to the lower suture, and bounded by two very minute entire threads, between which it is very elevated and rounded, and crossed by numerous close rounded ridges, which are probably again crossed by about six similar spiral threads. Ornament of the body-whorl below the sinus-band very similar to that above.

*Size*.—Height 13 mm., width 12 mm.

*Localities*.—In the Barnstaple Athenæum is one poor specimen from Vicarage Well, and one from Top Orchard; in the Museum of Practical Geology are two (a specimen and a cast) from South Petherwyn, and an external cast from "Marwood Beds, East of Barnstaple"; in the Woodwardian Museum is Sowerby's original type, and a fine cast from South Petherwyn, and a poor specimen from Top Orchard; in the Porter Collection a fragmentary specimen from Roborough.

*Remarks*.—The above description is taken chiefly from South Petherwyn shells. The figured mould from Barnstaple differs slightly from the rest. It has closer and slighter transverse threads, and three subsidiary minute threads between the larger spiral threads, and its sinus-elevation is sharper. There seems considerable variation in height. The cast from South Petherwyn, in the Museum of Practical Geology, is so like Phillips's fig. 177\*, that it may be its original; if so, that figure belongs to the present species, and not to *Pl. victrix*<sup>1</sup> as I formerly thought possible.

*Affinities*.—*Pl. Hamlingii* is distinguished by the section of its whorl being approximately quadrangular instead of triangular, and by its sinus-band being situated high on the shoulder and followed below by a broad perpendicular back, on which are several distant spiral threads.

*Pl. minima* or *minuta*, F. A. Römer, is a cast very similar to that represented by fig. 12, and might very well belong to this species; but, as its ornament is undescribed, it is impossible definitely to identify it. It occurs in the Wissenbach Slates.

*Pl. Orbigniana*, D'Arch. and de Vern,<sup>2</sup> and its variety, *Pl. Beaumonti*, d'Arch. and de Vern,<sup>3</sup> are distinguished among other points by their sunken sinus-band.

<sup>1</sup> 1891, Whidborne, 'Dev. Faun.,' vol. i, p. 301, pl. xxviii, figs. 15, 16.

<sup>2</sup> Ibid., p. 283, pl. xxvii, fig. 4.

<sup>3</sup> 1842, D'Arch. and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, pt. 2, p. 361, pl. xxxiii, figs. 1, 1 a.

*Pl. (Gyroma) Baconnierensis*, Ehlert,<sup>1</sup> has a deeper suture-line, a smaller and less conical spire, a coarser ornament, and a concave sinus-band.

*Pl. interstitialis*, Phillips<sup>2</sup> differs in the character of its sinus-band and other particulars.

4. *PLEUROTOMARIA*, sp. Pl. V, fig. 9; and Pl. VI, fig. 8.

*Description*.—Shell minute, very elevated, of several rather broad and slowly-increasing, convex whorls. Suture deep. Surface ornamented with several high, unequal, subacute, concentric ridges, which are crenulated by more numerous elevated, rounded, transverse threads, arching backwards from the upper suture, and very strong on the sinus-band, which appears to be elevated, rounded, and situated at or about the centre or wider part of the back in the body-whorl.

*Size*.—Length about 4 mm.

*Localities*.—In the Porter Collection are two imperfect specimens from Pilton.

*Remarks*.—It appears to me that these specimens are more likely to belong to some very lofty species of *Pleurotomaria* than to *Murchisonia*, but their state of preservation is too imperfect to permit any definite opinion to be formed at present upon them.

2. *Genus*—MURCHISONIA, Phillips, 1841.

1. MURCHISONIA ANGLICA, d'Orbigny. Pl. VI., fig. 14.

1841. MURCHISONIA ANGULATA, Phillips. Pal. Foss. (not Geol. Yorks.), p. 101,  
pl. xxxix, fig. 189.

1849. — ANGLICA, d'Orbigny. Prodrôme, vol. i, p. 76.

1891. — TURBINATA (pars)? Whidborne. Dev. Fauna, vol. i, p. 307.

*Description*.—Shell small, elevated, turritid, of comparatively few whorls. Spire conical, exceeding the body-whorl in height. Whorls very broad, convex, arching out obliquely from the suture with a gentle curvature to the widest part, which is three-quarters the way down, and then rapidly curving in to the lower suture. Sinus-band broad, elevated, concave, angular, situated near the base of the whorl.

<sup>1</sup> 1887, Ehlert, 'Bull. Soc. Étud. Sci. Angers,' Ann. 1887, p. 32, pl. viii, figs. 7—7 c.

<sup>2</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 227, pl. xv, figs. 10, 10 a.



*Size*.—A fragment containing three whorls, measures 9 mm. long, and 5 mm. wide.

*Locality*.—One specimen is in the Porter Collection from Pilton; and one in my Collection from Pouch Bridge. Phillips records it from Brushford and South Petherwyn.

*Remarks*.—When describing *M. turbinata*, Schlot., from South Devon, I was unable to find the specimen which Phillips figured in his 'Pal. Foss.' under the name of *M. angulata*, Ph., and it then appeared to me that it might very probably be a crushed or contorted specimen of Schlotheim's most variable shell. Since then, however, I have obtained specimens which exactly agree with Phillips's figure, and show that it represented the true form of the shell. These prove it to be undoubtedly a distinct species, distinguished by the great breadth of its rapidly increasing whorls, by its sinus-band being situated very near the lower suture, and by the obliquely convex shape of the whorls, as well as by its very small size.

The sinus-band is formed of two coalesced keels, but my specimen, probably from its imperfect state, does not show the lower (third) keel described by Phillips.

Miss Donald, who, as well as Mr. J. F. Whiteaves, discusses the various shells under the name *M. angulata*, shows that the Devonian species is distinct from the two Carboniferous species to which Phillips had previously applied the same name. Hence it must bear the name under which D'Orbigny long ago separated it from them.

While, however, these two references to Phillips and D'Orbigny must be removed from the list of synonyms of *M. turbinata*, there seems no doubt that the *M. angulata* of d'Archiac and de Verneuil, Goldfuss, and other later authors is distinctly a variety of Schlotheim's shell, and has nothing to do with the present form.

## 2. MURCHISONIA, sp. Plate VI, fig. 15.

*Size*.—Height 18 mm., width 9 mm.

*Locality*.—An obscure cast from Baggy Point is in the Museum of Practical Geology.

*Remarks*.—The above-named specimen appears to me to be quite distinct from *M. anglica*. It is much larger, its whorls are much narrower, and the sinus-band seems only slightly below the centre of the whorls. It thus is much more like *M. turbinata*, and perhaps may be the cast of one of the varieties of that shell; but it is in much too imperfect a condition to make it safe to refer it to it without further evidence.



It may be noticed that the sutural angle varies considerably, the spire having been imperfectly coiled as often happened in *M. turbinata*.

### 3. MURCHISONIA SIMILIS, *Trenkner*. Plate V, figs. 22—23 a.

1867. MURCHISONIA SIMILIS, *Trenkner*. Paläont. Novitat., pt. 1, p. 10, pl. i, fig. 17.  
 1868. — QUADRICINCTA, *Trenkner*. Ibid., pt. 2, p. 22, pl. vii, fig. 10.  
 1884. — SIMILIS, *Clarke*. Neues Jahrb. f. Min., Beil.-Band 3, p. 346, pl. v, fig. 14.  
 1893. — sp., *Tschernyschew*. Mém. Com. Géol., vol. iv, pt. 3, p. 38, pl. 3, fig. 12.

*Description*.—Shell very small, elongate, conical, turrited, of seven or eight slowly increasing whorls. Apex sharp. Sutures simple, rather shallow. Whorls rather narrow, convex, much exposed. Ornament consisting of a fine elevated crenulated thread immediately below the suture, two other threads bounding the sinus-band, which lies just below the centre of the back, and a fourth thread not quite half-way from the sinus-band to the lower suture; the whole crossed by microscopical, close and regular, transverse lines, which are nearly straight, and slope very obliquely backward from the sutures, and then arch to meet on the sinus-band. Body-whorl possibly rather larger than the others. Umbilicus apparently shallow and concave.

*Size*.—A specimen retaining the four lowest whorls is 5 mm. high by 2 mm. wide.

*Localities*.—There are five specimens (moulds) from Vicarage Well, Pilton, in the Barnstaple Athenæum.

*Remarks*.—The three lower longitudinal threads divide the whorl into four bands, and are so placed that the two central bands, the upper of which is the sinus-band, are rather narrower than the upper, and sometimes than the lower, marginal band. The transverse ornament is very minute, and only visible in good lights. I did not observe it till after the figures were drawn, and, in fact, it is too fine to be represented in them. It is, however, very regular and definite, and proves the shell to belong to *Murchisonia*.

Our specimens appear to agree with *Trenkner*'s figure of *M. similis*, but to be less aciculate than the fossil given by him as *M. quadricincta*, and refigured by *Clarke*. The latter name has been applied by *Pacht*<sup>1</sup> to another small species which is perhaps distinguished by being shorter, by having more angular whorls, and by a different arrangement of the longitudinal threads.

<sup>1</sup> 1854, *Pacht*, 'Dev. Kalk. Livland,' p. (295), plate, fig. 1; and 1858, *Pacht*, in *Baer* and *Helmersen*'s 'Beitr. Russ. Reiches,' vol. xxi, p. 101, pl. v, figs. 9 a, b.

*Affinities.*—*Aclisina longissima* seems distinguished by its much more aciculate form, and more numerous threads, and by the absence of transverse lines and sinus-band.

*Loxonema gracillimum*, Whiteaves,<sup>1</sup> is a longer shell with broader whorls, direct transverse threads and no sinus-band.

*M. bistriata*, F. A. Römer,<sup>2</sup> seems longer and more conical, and has only two spiral threads. As given by Geinitz,<sup>3</sup> it is much more like our shell, but is described as having only three spiral threads.

## VII. Family—BELLEROPHONTIDÆ, M'Coy, 1851.

### 1. Genus—BELLEROPHON, de Montfort, 1808.

#### 1. BELLEROPHON (BUCANIA) ELEGANS, d'Orbigny. Pl. VII, figs. 1, 1 a.

- |         |   |  |
|---------|---|--|
| 1840.   | BELLEROPHON ELEGANS, de Ferussac and d'Orbigny. | Nat. Hist. Ceph.,<br>p. 203, (Bellerophon) pl. vii, figs. 15—18.                 |
| ? 1840. | — CLATHRATUS, de Ferussac and d'Orbigny.        | Ibid., p. 204, pl. v,<br>figs. 24—27, and pl. vii, figs. 12—14.                  |
| ? 1842. | — ELEGANS, d'Archiac and de Verneuil.           | Geol. Trans., ser. 2,<br>vol. vi, pt. 2, p. 354, pl. xxix, figs. 2, 2 a,         |
| ? 1843. | — DECUSSATUS, de Koninck (pars).                | Desc. Anim. Foss. Carb.<br>Belg., p. 339, pl. xxix, fig. 3, and pl. xxx, fig. 3. |
| 1848.   | — ELEGANS, Bronn.                               | Index Palæont., p. 163.  |
| 1849.   | — DECUSSATUS, d'Orbigny (pars).                 | Prod., vol. i, p. 126.   |
| ? 1883. | BUCANIA ELEGANS, de Koninck.                    | Ann. Mus. Roy. H. N. Belg., vol. viii, pt. 4,<br>p. 151, pl. xli, figs. 18—21.   |
| ? 1883. | — ARCHIACI, de Koninck.                         | Ibid., p. 151.   |

*Description.*—Shell small, discoid, rather flat. Aperture expanded. Whorls convex, rather obliquely flattened on the sides, and rapidly curving in round the umbilicus. Keel large, elevated, sub-triangular or rounded. Umbilicus open. Surface ornamented with distant, strong, rather unequal, radiating threads, crossed by finer and closer arching threads or lines of growth.

*Size.*—About 2.5 mm. wide and 2.5 mm. high.

*Locality.*—One tiny specimen from Pilton is in the Porter Collection.

*Remarks.*—Our specimen is decoriated, and partly embedded in matrix. The striæ are clear near the mouth, but the ornament of the keel cannot be traced. It is possible from its small size and general appearance that it may be a young shell.

<sup>1</sup> 1892, Whiteaves, 'Contr. Canad. Pal.,' vol. i, pt. 4, p. 337, pl. xlv, fig. 10.

<sup>2</sup> 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. 1, p. 37, pl. v, fig. 26.

<sup>3</sup> 1853, Geinitz, 'Verst. Grauw. Sachsen,' pt. 2, p. 42, pl. xi, fig. 9.

It closely resembles and probably belongs to the Devonian *Bellerophon elegans*, d'Orbigny, although its ornament seems to be set more closely. In that respect it agrees with the Carboniferous *B. clathratus*, d'Orbigny, which its describer distinguishes from the former species by its having only three longitudinal threads on the keel instead of numerous finer lines. These two species de Koninck unites; but he separates from them *B. elegans*, d'Archiac and de Verneuil, on account of its wider and flatter keel. It appears to me that in that particular our fossil agrees with *B. elegans*, as originally given by d'Orbigny, and comes exactly half-way between d'Archiac and de Verneuil's and de Koninck's versions of it. On the whole it may prove that the species was variable and long-lived.

*Affinities*.—From *Euphemus Barumensis*, the only North Devon species at all resembling it, it is at once distinguished by its open umbilicus and elevated keel.

*B. Vogulicus*, Tschernyschew,<sup>1</sup> is a narrow, more rapidly-increasing form with a closed umbilicus.

## 2. BELLEROPHON LABYRINTHODES, n. sp. Plate VIII, figs. 1—2 b.

*Description*.—Shell small, convex, globose, horizontally symmetrical, probably of rather numerous whorls. Umbilicus rather large, expanding laterally. Whorls nearly evenly convex, bearing a central narrow elevated sinus-band, which is bordered by elevated threads and crossed by minute arching striæ. Surface-ornament very minute, so as to be invisible to the naked eye, consisting of close zigzag rows of puncta between sharp ridges, which are scored by the puncta, about four zigzags occupying each side of the shell-surface; beneath which are sometimes seen indications of larger transverse arching growth-lines and radiating ribs.

*Size*.—Height 11 mm., width 8 mm.

*Localities*.—In the Barnstaple Athenæum are several specimens on two slabs from Kingdon's, Shirwell, and one from Top Orchard, all of which are casts except one. In the Museum of Practical Geology is a specimen from Baggy Point.

*Remarks*.—This is a very beautiful and highly ornamented species. The ornament is microscopical, but it is much in the style of *B. Hicksii*,<sup>2</sup> except that it is much finer and more definitely zigzag. Roughly speaking, the pattern is reticulate, the zigzagging being only visible in some lights. The Baggy specimen is rather more coarsely and definitely marked, and under the superficial ornament it shows signs of transverse ribs like those of *B. costatus*, and radiations like those of *Eu. Urvii*. It is possible that the latter are the true ornaments, and that the finer

<sup>1</sup> 1893, Tschernyschew, 'Mém. Com. Géol.,' vol. iv, No. 3, p. 159, pl. iii, figs. 1 a—d.

<sup>2</sup> 1891, Whidborne, 'Dev. Faun.,' vol. i, p. 326, pl. 31, figs. 7—8 a.



pattern may have been superficially super-imposed by a mantle. Occasionally the cast shows indications of the sinus-band by an obscure elevation.

*Affinities.*—The casts of *Salpingostoma? macromphalus*, F. A. Römer, sp., from Kingdon's, Shirwell, are somewhat similar to this species, though their possession greatly and rapidly expanding lips, which makes it probable that they are identical with the smooth-shelled German fossil, clearly distinguishes them; and the present shell also differs in being much higher and more definitely globose. It seems to me that they are undoubtedly distinct.

This species sufficiently approaches d'Archiac and de Verneuil's version<sup>1</sup> of *Bellerophon tuberculatus*, de Ferussac, to raise the question whether it might not be identical. On referring, however, to d'Orbigny's<sup>2</sup> description and figures it is at once seen to be distinguished by the much finer and less moniliform character of its ornament. In the latter shell the tubercles are definite, and though a quincuncial arrangement is mentioned, the elaborate zigzagging of the intermediate furrows is hardly if at all apparent. It is also a much larger shell, and its whorls seem to increase somewhat less rapidly.

### 3. BELLEROPHON SUBGLOBATUS, M'Coy. Plate VIII, figs. 3, 3 a.

- |       |                       |  |  |
|-------|-----------------------|--|--|
| 1841. | BELLEROPHON GLOBATUS? | <i>Phillips</i> (not <i>Sowerby</i> ). | Pal. Foss., p. 108,<br>pl. xl, fig. 202 a—b                      |
| 1854. | —                     | —                                      | <i>Pacht</i> . Dev. Kalk. Livland, p. 206.                       |
| 1855. | —                     | SUBGLOBATUS, M'Coy.                    | Brit. Pal. Foss., p. 400.  |
| 1858. | —                     | GLOBATUS, <i>Pacht</i> .               | In Baer and Helmersen's, Beitr. Russ. Reiches, vol. xxi, p. 102. |

*Description.*—Cast of shell small, globose, horizontally symmetrical, apparently of numerous, slowly increasing, involute whorls. Whorls generally very much flattened on the back and deeply convex on the sides, but occasionally sub-angular on the back and obliquely flattened on the sides. Umbilicus very small and deep.

*Size.*—Height 9 mm., diameter through sinus-band 7 mm.

*Locality.*—In the the Barnstaple Museum are four specimens (including a slab with indeterminate fragments) from Sloly, and four from Baggy Point. In the Museum of Practical Geology are six from the Marwood Beds, and eight from Shirwell (Marwood Beds). In the Woodwardian Museum is one from Baggy Point.

*Remarks.*—These specimens are all casts in soft brown sandstone, and hence

<sup>1</sup> 1842, D'Archiac and de Verneuil, 'Geol. Trans.,' ser. 2, vol. vi, pt. ii, p. 353, pl. xxviii, fig. 9.

<sup>2</sup> 1840, de Ferussac and d'Orbigny, 'Hist. Nat. Ceph.,' p. 191, (*Bellerophon*) pl. i, fig. 10, and pl. iii, figs. 7—10.

do not admit of a complete description. The matrix shows that they belong to the Marwood series. The rate of increase of the whorls is very slow, and in none of them is there any sign of any labial expansion. In one of the specimens there is a slight indication of a central depression on the back; and in another (which is figured on Pl. VIII) there is an equally slight suggestion of a central keel. In the latter specimen there also appears an oblique flattening of the back on each side of the median line, which is not usually seen. In one or two cases very faint and doubtful marks exist, which possibly indicate that it was ornamented in the style of *B. lineatus*, Sandberger.<sup>1</sup>

These appear to be the shells described by Phillips as *B. globatus*, Sow.,<sup>2</sup> from "Marwood, Pilton, Brushford, &c.," though in his figures the umbilicus seems larger, and there seems some indication of ornament. The central of his six figures is the most like our shells. They were separated from *B. globatus* by M'Coy on account of their small umbilicus, and they also differ from it in the slow rate of increase of their whorls. Whether they are distinct from all the accompanying shells whose ornament is known cannot at present be positively asserted. They bear some likeness to young or imperfect specimens of *S. ? macromphalus* of the Pilton beds, but differ in being smaller, and in having a smaller umbilicus, and no signs of any labial expansion.

They also approach in general shape *B. labyrinthodes*, but seem to have more slowly increasing whorls.

#### 4. BELLEROPHON ? sp. Plate VIII, fig. 7.

*Description.*—Cast of shell small, discoid, oval, flattish. Spire consisting of three rapidly increasing whorls, deeply sunken, probably very similar above and below. Whorls vertically narrow, horizontally wide, convex (the convexity being much greatest on the back), slightly involute (the outer whorl enveloping one-third of the whorl within). Umbilicus open, with a spiral concavity formed by the suture. Mouth slightly expanded. Margin of lip convex. Back deeply and evenly convex, not keeled.

*Size.*—Height about 4 (?) mm., width 6 mm., depth 9 mm.

*Localities.*—Two specimens from Vicarage Well, Pilton, are in the Barnstaple Museum.

*Remarks.*—These specimens are very indistinct and puzzling. They give so

<sup>1</sup> 1896, Whidborne, 'Dev. Fauna,' vol. i, p. 321, pl. xxxi, figs. 3—6. Holzapfel calls this species *B. striatus*, Bronn, 1839, but Fleming, in 1828, described a Carboniferous form like *B. elegans* under the same name, and his description is definite, though unaccompanied by a figure.

<sup>2</sup> 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 604, pl. iii, fig. 15.

few characters that it is impossible to be sure about their right position. On the whole it seems most likely that they belong to a discoidal form of *Bellerophon*.

*Affinities*.—From *B. compressus*, Sandberger,<sup>1</sup> which is the same as *B. Murchisoni*, d'Orbigny,<sup>2</sup> it differs by having flatter sides and a more convex back.

*B. Troostii*, d'Orbigny,<sup>3</sup> is very similar on the back, but much deeper.

In *B. capuloides*, Maurer,<sup>4</sup> a sinus-band is visible.

On the other hand, *Capulus immersus*, Barrande,<sup>5</sup> *C. contortus*, F. A. Römer,<sup>6</sup> and Giebel,<sup>7</sup> *C. gracilis*, Sandberger,<sup>8</sup> approach it in shape, but their spires do not seem in any case so regular and complete.

While, again, species of *Goniatites* often closely resemble it, it does not seem worth while to compare it with any of them in the absence of any indication of septa or suture-lines.

## 2. Genus or Sub-genus—SALPINGOSTOMA, F. Römer, 1876.

This genus is distinguished by having an interrupted or evanescent sinus-band, a very wide open umbilicus, and a very widely and rapidly expanded simple mouth.

### 1. SALPINGOSTOMA? MACROMPHALUS, F. A. Römer, sp.? Plate VIII, figs. 4, 4 a, 5, 5 a.

1843. *BELLEROPHON MACROMPHALUS*, F. A. Römer. Verst. Harzgeb., p. 32,  
pl. ix, figs. 3, 3 a.  
? 1844. — *MACROSTOMA*, F. Römer. Rhein. Uebergangsgeb., p. 80,  
pl. ii, figs. 6 a, b.  
? 1853. — — Sandberger. Verst. Rhein. Nassau, p. 182,  
pl. xxii, figs. 8, 8 a, 4 b.  
? 1876. *SALPINGOSTOMA MACROSTOMA*, F. Römer. Pal. Leth., pl. xxv, figs. 5, 5 a.  
1884. *BELLEROPHON MACROMPHALUS*, Beushausen. Abhandl. Geol. Specialk.  
Preuss., Band vi, pt. 1, p. 44, pl. ii,  
fig. 1.

<sup>1</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 180, pl. xxii, figs. 6—6 f.

<sup>2</sup> 1840, de Ferussac and d'Orbigny, 'Hist. Nat. Ceph.,' p. 210, (*Bellerophon*) pl. vii, figs. 1—3, and pl. viii, fig. 14.

<sup>3</sup> Ibid., p. 206, (*Bellerophon*) pl. vii, figs. 19, 20.

<sup>4</sup> 1880, Maurer, 'Neues Jahrb. f. Min.,' Beil.-Band i, p. 31, pl. ii, fig. 7.

<sup>5</sup> Ibid., p. 33, pl. ii, fig. 15.

<sup>6</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 26, pl. vii, figs. 1, 2.

<sup>7</sup> 1858, Giebel, 'Sil. Faun. Unterbarz.,' p. 24, pl. iii, fig. 7.

<sup>8</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 236, pl. xxvi, figs. 17, 17 a.



?1886. BELLEROPHON SANDBERGERI, *Maurer*. Faun. Rechrhein. Unterdev.,  
p. 20.

1891. — MACROMPHALUS, *Whidborne*. Dev. Fauna, vol. i, p. 327,  
pl. xxxi, figs. 10, 10 a.

*Description*.—Cast of shell rather large, subglobose, rather flattened, horizontally symmetrical. Spire elliptically coiled? Whorls flattened on the back, regularly and moderately convex round the upper and lower sides. Sinus-band indicated by a central depression in the cast until it approaches the aperture, where it rather suddenly rises into a rounded ridge. Umbilicus wide, curving regularly round, continuously with the lateral curves of the whorl. Mouth expanding rapidly to form broad transverse wings or expansions, so that the diameter of the mouth is three times that of the height of the shell a short distance behind it.

*Size*.—Height 40 mm. across the expanded mouth, 14 mm. across the umbilicus near the mouth; width through sinus-band 24 mm.

*Localities*.—In the Barnstaple Athenæum are five specimens from Kingdon's, Shirwell; and in the Museum of Practical Geology two from the Pilton Limestone of Marwood.

*Remarks*.—Though our specimens are all casts, a very minute fragment of shell remains on one of the figured specimens of them, and appears to show a minute ridge-like ornament.

This species is either identical with or very near akin to *S. macrostoma*, F. Römer; our specimens do not show an unbroken circle in the expansion of the mouth, perhaps simply on account of their imperfect condition, nor have they so wide an umbilicus.

*Bellerophon macromphalus*, F. A. Römer, has, according to his own figure and description, a very much larger and flatter umbilicus with more numerous narrow whorls; but, as revised by Beushausen, it seems almost exactly to agree with the present species. While all the material is confined to casts, it is hopeless to arrive at certain conclusions, but it seems clear that *B. macromphalus* and *B. macrostoma* are generically identical, and no reason seems assignable why they should not also be so specifically. The South Devon shells which I described from Chircombe Bridge show, I think, no difference from the North Devon fossils, except that they are circularly coiled, and that they are sometimes rather more angulated round the umbilicus—points which need not be indicative of specific distinction, as neither of them seems constant.

*Affinities*.—*B. Gostariensis*, F. A. Römer,<sup>1</sup> is said to differ from *S. macrostoma*, F. Römer, by its more involute and fewer whorls, the more sudden widening of

<sup>1</sup> 1855, F. A. Römer, 'Beitr. Harzgeb.,' pt. 3, p. 14, pl. iii, fig. 17.

the mouth, the strong keel on the back of the expansion, and the much smaller size of the spire. Whether in these particulars it agrees with the English shell I am not sure.

It may be noted that figures given by Hall<sup>1</sup> of his *B. pelops* show a similar keel in the cast, but a regular small round keel in the perfect shell. From our shells they differ in not having the mouth so extremely expanded.

### 3. Genus or Sub-genus—TROPIDODISCUS, Meek, 1866.

This genus or sub-genus contains shells akin to *B. trilobatus*, Sow., which are very flat, with very wide and open umbilici, and with a rounded convexity bounded by two concavities on the back of the whorl, but without any definite sinus-band.

De Koninck proposed to replace Meek's name by *Tropidocyclus*, because Stein in 1850 had used the name *Tropidiscus*. As Meek had himself emended the latter name, which he had used at first, there appears to be no reason for a further change.

Fischer<sup>2</sup> regards Meek's name as a synonym of *Cyrtolites*, Conrad, 1838.

#### 1. TROPIDODISCUS TRILOBATUS, Sowerby? var. BISULCATUS, F. A. Römer. Plate VIII, figs. 6, 6 a.

- |         |                                  |   |
|---------|----------------------------------|---|
| ? 1839. | BELLEROPHON TRILOBATUS, Sowerby. | In Murchison, Sil. Syst., p. 604, pl. iii, fig. 16.   |
| 1840.   | —                                | — de Ferussac and d'Orbigny. Hist. Nat. Ceph., p. 209, (Bellerophon) pl. vii, figs. 34—37, and pl. viii, fig. 13. |
| 1841.   | —                                | — Phillips. Pal. Foss., p. 107, pl. xl, figs. 200 a—e.  |
| 1843.   | —                                | BISULCATUS, F. A. Römer. Verst. Harzgeb., p. 32, pl. ix, figs. 1 a, b.  |
| ? 1843. | —                                | TRILOBATUS, F. A. Römer. Ibid., p. 32, pl. xii, fig. 39.  |
| 1853.   | —                                | — var. TYPUS, Sandberger. Verst. Rhein. Nassau, p. 177, pl. xxii, figs. 2, 2a.                                    |
| 1855.   | —                                | BISULCATUS, M'Coy. Brit. Pal. Foss., p. 400.  |
| 1877.   | —                                | TRILOBATUS, Øhlert. Bull. Soc. Géol. Fr., ser. 3, vol. v, p. 580.   |

<sup>1</sup> 1879, Hall, 'Pal. N. Y.', vol. v, pt. 2, p. 95, pl. xxii, figs. 7—13.

<sup>2</sup> 1887, Fischer, 'Manuel Conchyl.', p. 854.

1884. BELLEROPHON BISULCATUS, *Beushausen*. Abhandl. Geol. Specialk. Preuss.,  
vol. vi, pt. 1, p. 45, pl. ii, fig. 3.  
1893. — — — ? *Collins*. Trans. Roy. Geol. Cornwall, vol. xi,  
p. 38.

*Description*.—Shell very small, not quite horizontally symmetrical, wider than high. Spire rapidly increasing. Umbilicus very large. Whorls deeply convex on the shoulder, then becoming concave till they rise in the central part into a large elevated convexity, and returning with the same sweep reversed to the umbilicus. Surface quite smooth, with no signs of sinus-band or ornament.

*Size*.—Height 7 mm., width 8 mm.

*Localities*.—In the Museum of Practical Geology are two specimens from Baggy Point and one from West Angle Bay, Pembrokeshire; and in the Woodwardian Museum one from west of Saunton Court.

*Remarks*.—Whether *B. trilobatus*, Sowerby, is a long-lived and variable species, or whether there are several distinct kindred forms bearing the same facies, is a question on which I have not yet been able to arrive at a satisfactory conclusion.

As figured by Sowerby and F. A. Römer, *B. trilobatus* is a much more globose form. Sandberger gives three varieties, *acutus*, *typus*, and *tumidus*; the first almost flatly discoidal, the second corresponding to *B. bisulcatus*, F. A. Römer, and the third as globose as Sowerby's types. Of these, Ehlert remarks that he has collected all three in Mayenne in the midst of intermediate forms. Again, Phillips gives three varieties from Devonshire, one of which agrees with Sowerby's shell in globosity, and this is apparently the one which he quotes from Baggy.

Furthermore, the specimens which I have myself seen agree with *B. bisulcatus*, F. A. Römer, though they do not seem distinguishable from Silurian specimens in the Museum of Practical Geology, with which I have compared them.

M'Coy in 1855 separated the Devonshire shell from the Silurian under the name *B. bisulcatus*, Römer.

Beushausen in 1884 treated *B. trilobatus*, *B. bisulcatus*, and *B. tumidus*<sup>1</sup> as distinct species, while in 1889 Sandberger<sup>2</sup> himself separated *B. tumidus* from *B. trilobatus*. In this he is followed by Kayser<sup>3</sup> in 1895, who, moreover, describes a distinct sinus-band with marginal threads on some specimens of *B. tumidus* from Pepinster.

The *B. trilobatus* of d'Orbigny appears exactly to agree with *B. bisulcatus*, F. A. Römer, and our specimens.

On the whole it seems best, at least as a provisional arrangement, to treat

<sup>1</sup> 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' vol. vi, pt. 1, p. 44.

<sup>2</sup> 1889, Sandberger, 'Jahrb., Nass. Ver. Naturk.,' vol. xlii, pp. 13, 25.

<sup>3</sup> 1895, Kayser, 'Ann. Soc. Géol. Belg.,' vol. xlii, p. 182, pl. iv, figs. 5—8.



our shell (which may be taken as identical with *B. bisulcatus*) as a variety of Sowerby's species.

At the same time the *B. tumidus* of Kayser, and perhaps also that of Beushausen, must, from their defined keel, be regarded as distinct, though there is possibly more reason for retaining *B. trilobatus*, var. *tumidus*, Sandberger, as a variety of Römer's shell.

*Affinities*.—De Koninck's three Carboniferous species of the genus are all distinguished by elaborate ornament.

*B. compressus*, Sandberger,<sup>1</sup> which is the same as *B. Murchisoni*, d'Orbigny,<sup>2</sup> has a striated keel and no lateral concavities.

#### 4. Genus or Sub-genus—EUPHEMUS, M'Coy, 1844.

This genus was formed by M'Coy, and revived by Waagen and de Koninck, for shells of the type of *Bellerophon Urii*, Fleming. It appears individualised by several definite characters, among which may be mentioned the nature of the ornament, which de Koninck seems to regard as produced by the animal only on the old parts of its shell, and as taking the place of the smooth callosities seen in those parts in other genera of the family. The sinus-band is often well marked in the newer part of the shell, but is more or less obliterated in the striated portion.

De Koninck describes five species from the Carboniferous of Belgium, all of which seem very closely allied.

##### 1. EUPHEMUS BARUMENSIS, n. sp. Plate VII, fig. 2.

1841. *BELLEROPHON URIL*, Phillips (not Fleming). Pal. Foss., p. 106, pl. xl, figs. 199 a—d.

1843. ' — — ? , F. A. Römer. Verst. Harzgeb., p. 32, pl. xii, fig. 38.

*Description*.—Shell very small, globose. Whorls evenly and spherically rounded, and transversely symmetrical, bearing about twenty fine, regular, simple, erect, very distant spiral lines, which are most distant at the centre of the back, and seem to vanish at the apex and umbilicus. Interspaces flat. Shell-structure massive.

*Size*.—About 4 mm. high, 5 mm. wide.

*Locality*.—In the Museum of Practical Geology is a specimen from Baggy Point, which is the original of Phillips's fig. 199 b.

<sup>1</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 180, pl. xxii, figs. 6—6f.

<sup>2</sup> 1840, De Ferussac and d'Orbigny, 'Hist. Nat. Ceph., p. 210 (Bellerophon), pl. vii, figs. 1—3.

*Remarks.*—Phillips figures two specimens, and adds the following particulars:—aperture very expanded; no umbilicus, no band; ridges crenulated; furrows crossed by fine lines of growth, retroflexed from the mouth. Interior of the shell quite smooth.

There is certainly no keel, but there is a slight sign of a sinus-band between the two central ridges, shown by a faint indication of recurved growth-lines in it. The lateral lines of growth retroflexed from the mouth are also just visible. There are no signs whatever in our specimen of the crenulations on the spiral ridges which are described by Phillips. It seems, however, possible that Phillips's enlarged pattern ('Pal. Foss.,' fig. 199 *d*) may have been taken from this specimen as well as his other figure, and if so the signs of crenulation in it are deceptive, being due to a slight fracture of the summits of the ridges.

*Affinities.*—It is difficult to define the species from the small portion visible in our only specimen. From the true *Eu. Urvii*,<sup>1</sup> as restricted by de Koninck,<sup>2</sup> it is distinguished by the absence of an elevated keel. *Eu. Orbignii*, de Koninck,<sup>3</sup> has coarser and closer spiral ridges. *Eu. Horioni*, de Koninck,<sup>4</sup> has more numerous striæ. *Eu. invitabilis*, de Koninck,<sup>5</sup> has more unevenly arranged ridges, and is a flatter shell. *Eu. filusus*, de Koninck,<sup>6</sup> seems to approach nearest to it, but differs in the same particulars. As, however, our specimen only shows the inner whorl, it is hard to say whether these distinctions would remain true if a perfect specimen of it could be compared. At the same time it seems most probable that they would, and that they are sufficient to give this form a claim to a distinct name; especially considering that, as it belongs to a different formation from the above-mentioned shells, the presumption is that they are distinct. Moreover, though Römer's figure of his Devonian shell is very poor, it shows that, if it represents the present species, its shape is very different from that of any of the Belgian forms.

D'Orbigny figured the young shell of *Oxygyrus Keraudreni*, Rang,<sup>7</sup> of which he remarked that it is so like in shape and ribbing that it would be hard to distinguish it if it came from beds of the same age, and which he considered to be evidence of the relationship of *Bellerophon* to the *Atlantidæ*.<sup>8</sup>

<sup>1</sup> 1828, Fleming, 'Hist. Brit. Anim.,' p. 338.

<sup>2</sup> 1883, de Koninck, 'Ann. Mus. Roy. Hist. Nat. Belg.,' vol. viii, p. 157, pl. xlii, figs. 40—43.

<sup>3</sup> Ibid., p. 156, pl. xlii, figs. 5—7; and pl. xliii, figs. 9—13.

<sup>4</sup> Ibid., p. 159, pl. xliii, figs. 18—21.

<sup>5</sup> Ibid., p. 159, pl. xliii, figs. 22—25.

<sup>6</sup> Ibid., p. 160, pl. xliii, figs. 14—17, 26—34.

<sup>7</sup> 1840, de Ferussac and d'Orbigny, 'Hist. Nat. Ceph.,' p. 198 (*Bellerophon*), pl. vi, figs. 1, 2.

<sup>8</sup> 1887, Fischer, 'Manuel Conchyl.,' p. 582, fig. 347.

CLASS—LAMELLIBRANCHIATA, *Blainville*, 1814.

The abundance of bivalves in these beds is marked, though except in a few cases it is rather in the form of a variety of species than a profusion of individuals. In some cases, especially in the Marwood zone, specimens occur in crowds; for instance, *Cucullæa unilateralis*, Sowerby, and *Ptychopteria Damnoniensis*, Phillips, sp., are evidently gregarious, while *Prothyris scalprata*, n. sp., completely covers one rock-surface. In the Marwood beds, however, the number of species is few; but as we advance into the Pilton Zone we find, though shells are fewer, species are greatly increased; and there, though some are found commonly, most are only known by one or two examples.

Sixteen species were quoted from this area by Phillips, but of these, five seem only synonyms. On the other hand, many of his South Petherwyn species are found also to occur here. Not a few of the fresh forms bring out the relationship to the American Devonians, and it seems remarkable how often light has been thrown on our English species by the resemblance, not generally amounting to specific identity, of Transatlantic shells.

1. ORDER—DESMODONTA, *Neumayr*, 1883.<sup>1</sup>I. Family—PRÆCARDIIDÆ, *Rudolf Hörnes*, 1884.1. Genus—PANENKA, *Barrande*, 1881.

This genus being known only by its external characters, its position is doubtful. Fischer includes it and its congeners, *Præcardium*, &c., in a provisional family of his sub-order *Anatinacea*; Neumayr (1891) places it under his order *Palæoconcha*, Beushausen under *Cardioconcha*, Zittel under *Homomyaria*. Possibly its rightful place will ultimately be found to be near some genera now included in the enlarged order *Desmodonta*.

## 1. PANENKA ANGLICA, n. sp. Plate VIII, figs. 10, 11, 11 a.

*Description*.—Shell large, transverse, convex. Umbo small, incurved, facing forward, and situated at about the anterior third of the length. Lunule large but undefined. Surface covered by 35 or 45 regular, even, close-set, rounded rays, of

<sup>1</sup> Neumayr's classification has been mainly adopted by Zittel in his 'Palæozoologie,' 1895, who is followed here.



which the eight or ten situated medianly are decidedly narrower than those on each side, and which seem gradually to increase in size laterally, and are divided by concave furrows narrower than the ribs. Transverse ornament consisting of numerous regular, fine, close, strong, transverse striæ or threads, which cross the ribs as well as their intervals.

*Size of a distorted specimen*: height 60 mm., length 70 mm., depth 15 mm.

*Localities*.—An imperfect and distorted specimen from Top Orchard is in the Barnstaple Athenæum; another from Braunton in the Museum of Practical Geology; and a third from Barnstaple in the Woodwardian Museum.

*Remarks*.—The first two specimens have been regarded as the *Avicula pectinoides*, Sowerby,<sup>1</sup> but a comparison of the type of that species and M'Coy's description of it with our specimens and with *Aviculopecten (Meleagrina) rigida*, M'Coy,<sup>2</sup> which M'Coy doubtfully identified with it,<sup>3</sup> shows that it is quite impossible for them to belong to it. Moreover the third specimen is sufficiently perfect to remove all doubt.

On the other hand, their likeness to the lengthy series of species referred by Barrande to his genus *Panenka* is so great that there can remain no question against their belonging to that genus. While, however, their generic position may be regarded as certain, the very vastness of the numbers of species described from Bohemia renders it the more difficult to decide whether our crushed and distorted English shells agree with any of them. At present I know of no Bohemian species with which it seems safe to unite the present form.

Its chief characteristics seem to be (1) the smallness of the central ribs, five of which occupy the same space as four of the lateral ribs; (2) the strong, close, thread-like, transverse striæ; and (3) the strength of the ribbing on the latero-superior parts of the shell.

The Bohemian shell that agrees best with our specimens in the second of these points is *Panenka sphæroides*, Barrande,<sup>4</sup> and of it Barrande only figures a single specimen, which is as imperfect and distorted as ours. The shell may be more convex, and the umbo more central and more elevated than it is in ours, but it is impossible at present to decide whether these distinctions are valid, the true shape of neither form being known.

In *P. Bohemica*, Barr.,<sup>5</sup> and *P. domina*, Barr.,<sup>6</sup> the threading is finer, and the marginal ribbing generally fainter.

<sup>1</sup> 1840, Sowerby, 'Geol. Trans.,' ser. 2, vol. v, pt. 3, pl. liv, fig. 2.

<sup>2</sup> 1844, M'Coy, 'Synopsis Carb. Foss. Ireland,' p. 80, pl. xiii, fig. 16.

<sup>3</sup> 1855, M'Coy, 'Synopsis Brit. Pal. Foss.,' p. 393.

<sup>4</sup> 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. cccxxviii, figs. 7—10, Ét. G.

<sup>5</sup> Ibid., pl. lxxvii, figs. 4, 7—10; pl. xcvi, figs. 2, 1—4; pl. cxxxvii, figs. 1—10; pl. cxxxviii, figs. 1—22; pl. cxl, figs. 10—12; pl. cli, figs. 19—21; pl. ccliv, figs. 11—13, Ét. E; and pl. cccxxvi, figs. 1—4, Ét. G.

<sup>6</sup> Ibid., pl. cxvii, figs. 7, 8, and pl. cxx, figs. 4, 5, Ét. G.

In *P. amabilis*, Barr.,<sup>1</sup> the umbo is central and direct, and more acute.

In *P. intricans*, Barr.,<sup>2</sup> the threading is complicated by every fourth thread being larger.

In *P. obsequens*, Barr.,<sup>3</sup> the threading is somewhat similarly complicated and the umbo more central.

In *P. expansa*, Barr.,<sup>4</sup> the ribs, though expanding laterally, become small again almost immediately.

*P. gracilis*, Barr.,<sup>5</sup> closely resembles the specimen in the Barnstaple Athenæum in shape, and apparently is rather coarsely threaded, but it shows no signs of the central diminution of ribs. It is probable, however, that our shell has not retained its true shape, and the Bohemian shell too has signs of being distorted.

*Cardium rigidum*, F. A. Römer,<sup>6</sup> appears congeneric, but seems distinguished by having a more anterior umbo, rather more numerous ribs, no transverse threading, and no central diminution of the ribs.

*P. grandis*, Whiteaves,<sup>7</sup> is much larger and more transverse, and has still wider lateral ribs, and no transverse threads.

*P. potens*, Hall,<sup>8</sup> comes very close, but seems to have a more central and erect umbo and less strong concentric marks, and its ribs are fainter above.

## II. Family—GRAMMYSIIDÆ, *Rudolf Hoernes*, 1884.

### 1. Genus—LEPTODOMUS, *M'Coy*, 1844.

Shell oblong, transverse, trapezoidal, convex; anterior end rounded; posterior end truncated and gaping; surface transversely ribbed, generally with a central constriction; umbo arched, prominent, anterior; lunule deep; hinge straight, toothless; muscular impressions slight.

It appears to bear strong resemblance to the genus *Pholadomya*, but its pallial line is stated to be entire.

<sup>1</sup> 1881, Barrande, 'Syst. Sil. Bohém.,' vol. vi, pl. cxx, figs. 6, 7, and pl. cccxxxvi, figs. 9—11, Ét. G.

<sup>2</sup> Ibid., pl. cxxxv, figs. 1—7, Ét. E.

<sup>3</sup> Ibid., pl. cli, figs. 5—18, Ét. E.

<sup>4</sup> Ibid., pl. cliii, figs. 7—9, and pl. cclxxxiv, figs. 24, 25, Ét. F.

<sup>5</sup> Ibid., pl. ccexi, figs. 7—9; pl. ccxxxv, figs. 8, 9; and pl. cccxxxiii, figs. 1—6, Ét. G.

<sup>6</sup> 1866, F. A. Römer, 'Beitr. Harzgeb.,' pt. v, p. 10, pl. xxxv, fig. 1.

<sup>7</sup> 1891, Whiteaves, 'Canad. Record of Science,' Ann. 1891, p. 401, pl. i.

<sup>8</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 422, pl. lxix, figs. 8, 10.

## 1. LEPTODOMUS CONSTRICTA, M'Coy. Plate VIII, figs. 8, 9.

1841. CYPRICARDINIA IMPRESSA ? Phillips (not Sowerby). Pa Foss., p. 36,  
pl. xvii, fig. 58.

1855. LEPTODOMUS CONSTRICTUS, M'Coy. Brit. Pal. Foss., p. 396, pl. ii A,  
fig. 10\*.

*Description*.—Left valve large, transverse, subquadrate, convex. Umbo very large, wide and prominent, depressed in the centre, much elevated above the hinge-margin, situated at about the median third of the length. Hinge-margin long, slightly concave behind the umbo. Anterior margin arched, being oblique from the umbo to the anterior corner, which is rapidly rounded, and then oblique and moderately convex in its inferior part. Inferior margin long, slightly oblique, and convex but depressed in the centre. Posterior margin roundly convex, straighter and oblique above, and rounding into the hinge-margin. Lunule apparently long, lanceolate, excavate, bounded by a straight elevated line from the front of the umbo to the anterior point. Contour of back convex, with a wide, well-marked, subangular depression (running from the middle of the umbo straight and obliquely to the centre of the inferior margin) from each side of which the contour rises with a gentle convexity, being bounded laterally by the ridge of the lunule in front, and sloping gradually to the margin behind. Surface covered by about eleven or twelve large, low, rounded transverse ridges, which divaricate from the front, are lost in the median constriction, become again prominent for a short distance, and then vanish on the posterior part of the shell.

*Size* (of left valve).—Length 50 mm., height 33 mm., depth 11 mm.

*Localities*.—A fine specimen from Marwood is in the Museum of Practical Geology; M'Coy's type specimen and another small specimen from Marwood, and a poor specimen from Top Orchard, are in the Woodwardian Museum; another from Roborough is in the Porter Collection.

*Remarks*.—This is evidently the species to which M'Coy has given the name *L. constricta*, when describing its right valve from three specimens from Marwood.<sup>1</sup> He was inclined to think it the same as "the shell referred by Phillips (in the 'Pal. Foss.') to the Silurian *Cypricardia impressa* of Sowerby," and this, I think, our two figured specimens prove undoubtedly to be the case.

*Cypricardia* ? *impressa*, Sowerby,<sup>1</sup> itself is probably closely allied, but it seems to be smoother and more transverse, and to have a smaller and more anterior umbo.

*Affinities*.—It appears to me that the present species is closely allied to the German shell described by F. Römer as *Myacites impressus*,<sup>2</sup> but specifically differs

<sup>1</sup> 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 609, pl. v, fig. 3.

<sup>2</sup> 1844, F. Römer, 'Rhein. Uebergangsgeb.,' p. 79, pl. ii, fig. 4.



in having a larger umbo, in being much less transverse, in being more produced and angular on the anterior side, and in its concentric ridges fading rather more rapidly behind (so as to leave a rather larger smooth postero-superior portion), and also on the front side of the median depression.

*Myacites striatulus*, F. Römer,<sup>1</sup> which is nearer in shape, has strong radiations.

*Allorisma plicatella*, Ehlert,<sup>2</sup> is very similar, except that it has no median constriction, the concentric ribs being continuous over the whole back of the shell. It thus shows the proximity of *Leptodomus* to *Allorisma*.

*Grammysia constricta*, Hall,<sup>3</sup> which its author first described as *Grammysia* (*Leptodomus*?) *constricta*,<sup>4</sup> but without any reference to M'Coy's species, appears to be a rather variable form, usually with considerably more numerous concentric ridges, and of greater transverseness; the American specimens figured by Hall being normally twice as long as high, while ours, though perhaps variable, seem to be only half as long again as the height. If this means that the species are distinct, the name of the American form should become *Leptodomus Hallii*.

*Grammysia Hannibalensis*, Shumard,<sup>5</sup> agrees more nearly with our shell in dimensions, but its umbo is more anterior and oblique, and its constriction seems to range more backward.

*Leptodomus Canadensis*, Billings,<sup>6</sup> is closely allied, only differing in having a much smaller umbo and in being longer.

## 2. LEPTODOMUS SEMISULCATA, Sowerby, sp.? Plate IX, figs. 23, 24, 24 a.

? 1839. MODIOLA ? SEMISULCATA, Sowerby. In Murchison's Sil. Syst., p. 617, pl. viii, fig. 6.

1841. CYPRICARDIA SEMISULCATA, Phillips. Pal. Foss., p. 36, pl. xvii, figs. 57 a—c.

*Description*.—Shell moderate in size, very convex, transverse. Inferior margin apparently slightly concave in front, gently convex behind. Postero-inferior margin very convex. Postero-superior margin oblique. Valve with a vertical concave constriction very near the anterior side; and covered in with twenty or thirty strong, elevated, regular undulations, which vanish rather suddenly before reaching the posterior slope, and which are divaricated in the anterior constrict-

<sup>1</sup> 1844, F. Römer, Rhein. Uebergangsgeb., p. 79, pl. ii, figs. 5, 5 a.

<sup>2</sup> 1881, Ehlert, 'Mém. Soc. Géol. Fr.,' ser. 3, vol. ii, p. 34, pl. vi, figs. 3—3 b.

<sup>3</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 377, pl. lix, figs. 4, 5?, 13—20, and pl. lxxvii, figs. 26, 27.

<sup>4</sup> 1870, Hall, 'Prelim. Notice Lamellib.,' pt. 2, p. 58.

<sup>5</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 381, pl. lxi, figs. 29, 30, 33.

<sup>6</sup> 1874, Billings, 'Palæozoic Fossils Canada,' vol. ii, pt. 1, p. 54, pl. v, fig. 1.

tion so that their number is greatly reduced in front. Surface also ornamented with finer minute radiations and concentric lines (fig. 24 *a*).

*Size*.—Length about 35 mm.

*Localities*.—One specimen from Landlake is in the Museum of Practical Geology; one in the Barnstaple Museum from Sloly; and two in the Woodwardian Museum from S.W. of Sloly.

*Remarks*.—The crushed and fragmentary or obscured state of these specimens renders them very difficult to understand, but a comparison with Phillips's figures (the originals of which I have not seen) makes me believe that they are identical with them, while the type of Sowerby's Ludlow shell in the Museum of the Geological Society, though considerably larger, so closely resembles them that I do not see the way to separate them in the absence of more perfect specimens. As far as can be seen they appear to belong to the genus *Leptodomus*, but are distinguished from *L. constricta* by the much more anterior position of the constriction, the character of their ornament, their greater obliquity, and other points.

## 2. *Genus*—SANGUINOLITES, *M'Coy*, 1844.

This genus was originally defined by M'Coy, but made by himself and others to include many shells which are not congeneric. It has since been restricted by Hall, de Koninck, and Fischer.

### 1. SANGUINOLITES PORTERI, n. sp. Plate IX, figs. 2, 2 *a*.

*Description*.—Shell of moderate size, suboval, convex, very transverse. Hinge-line very long, straight. Umbo very much flattened, incurved, depressed, proximate, curving forward, extending slightly above the hinge-line, and situated about one-fifth or one-sixth from the anterior end. Anterior margin subangular, being concave above and convex below the angle. Inferior margin very wide, gently and evenly convex. Postero-inferior point produced, bluntly angular. Posterior margin short, straight, oblique. Keel, acute at first, then obscure, running from behind the umbo to the postero-inferior point, and dividing the shell into two portions, of which the postero-superior is obliquely concave and smooth, and the anterior transversely convex, and covered by about forty very regular, rounded, rather elevated, transverse ridges. Ridges divided by rather narrower furrows, and seeming to diminish in size from the keel forwards, and only to amalgamate very close to the anterior margin. Signs of a narrow lunule.

*Size*.—Height 14 mm., length 34 mm., depth of one valve about 4 mm.

*Locality*.—One specimen in the Porter Collection in rubbly brown stone from Pilton.

*Remarks*.—This fossil is distinguished from *S. minus*, n. sp., by the great regularity, prominence, and number of its ribs. Thus it approaches *Cardinia Devonica*, Geinitz,<sup>1</sup> but shows little sign of the lessening of the ribs on the marginal parts or of any median depression, and is further distinguished by its stronger keel and rounded base, and by the ribs being absent on the postero-superior region.

From *Leptodomus constricta*<sup>2</sup> it is distinguished by much more numerous ribs, lower umbo, and the absence of a median constriction.

*Sanguinolites angustatus*, Phillips, sp.,<sup>3</sup> the type of the genus, is much more transverse; and *S. discors*, M'Coy,<sup>4</sup> (Fischer's type), is very similar, but longer and more rounded in front.

2. SANGUINOLITES MIMUS, n. sp. (MS. Museum of Practical Geology). Plate IX, figs. 4, 6, 7 ?

*Description*.—Shell of medium size, transverse, convex, suboval. Umbo wide, depressed, flattened, proximate, situate at the anterior fourth of the length. Anterior side somewhat produced, flattened. Anterior margin obliquely convex below. Inferior margin long, slightly convex. Posterior margin roundly convex. Hinge-margin long, straight, slightly oblique. Contour of back vertically convex, horizontally slightly convex, but becoming steeply concave in front of umbo, and gently concave in the postero-superior slope. Postero-superior slope bounded by a convexity or incipient keel from rear of umbo to postero-inferior point, which is followed above by a linear concave depression running from beneath the umbo to the upper part of the posterior margin, and above that by a rounded thickening of the shell over the hinge-margin. Surface bearing about seventeen rather unequal and irregular concentric rounded ridges, separated by rather wider concave intervals and being smallest near the umbo, occasionally divaricating in front and becoming suddenly faint and invisible on the postero-superior slope. Minor ornamentation (at least on posterior parts) consisting of crowded microscopic transverse lineations.

*Size of left valve*.—Height 16 mm., length 34 mm., depth 5 mm.

*Localities*.—In the Museum of Practical Geology is a specimen from Croyde;

<sup>1</sup> 1853, Geinitz, 'Verst. Grauwack Sachsen,' pt. 2, p. 46, pl. xii, fig. 3.

<sup>2</sup> 1841, Phillips, 'Pal. Foss.,' p. 36, pl. xvii, fig. 58.

<sup>3</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 208, pl. v, fig. 2.

<sup>4</sup> 1844, M'Coy, 'Synopsis Carb. Foss. Ireland,' p. 49, pl. viii, fig. 4.



in the Barnstaple Athenæum one from Marwood, a cast and mould from Sloly, and a large fragment of the posterior side from Sloly, which shows the minor ornament; and in the Porter Collection two from Pilton.

*Remarks*.—One of the characteristics of this species seems the indistinct double swelling of the posterior slope. Its rather prominent and irregular ornament, which abruptly vanishes behind, seems another distinguishing feature.

*Affinities*.—*Pullastra complanata*, Sow.,<sup>1</sup> as given by Phillips,<sup>2</sup> differs by having the inferior margin concave, the posterior ridge stronger, and the surface smoother. Sowerby's own shell is also more deltoidal.

*Leptodomus semisulcata*, Phillips, sp.,<sup>3</sup> approaches it in ornament, but is very different in shape, being more convex, with a more anterior umbo and a dorsal constriction.

*Sanguinolaria lirata*, Phillips,<sup>4</sup> though looking somewhat similar in Phillips's figure, is really totally different in shape, character, and ornament. It belongs to the genus *Ctenodonta*.

*Glossites Manitobensis*, Whiteaves,<sup>5</sup> simulates it in ornament, but is narrower, and is more definitely flattened and smoothed behind.

*Sanguinolites concentricus*, Goldfuss,<sup>6</sup> or rather, Beushausen,<sup>7</sup> sp., appears to have stronger and more regular markings, which are continued over the posterior slope, and also a smaller and lower umbo. It was described by Goldfuss<sup>8</sup> under the name *Sanguinolaria sulcata*, Phillips,<sup>9</sup> but the original *S. sulcata* is very different, being wider behind, and without any posterior compression or truncation.

### 3. Genus—EDMONDIA, de Koninck, 1842.

Shell equivalve, oval or subcircular. Beaks central or anterior. Surface with concentric striæ, and sometimes obscure rays. Hinge narrow, edentulous. Ligament external. Muscle-marks superficial. Pallial line simple.

<sup>1</sup> 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 609, pl. v, fig. 7.

<sup>2</sup> 1841, Phillips, 'Pal. Foss.,' p. 35, pl. xvii, fig. 56.

<sup>3</sup> Ibid., p. 36, pl. xvii, figs. 57 *a—c*.

<sup>4</sup> Ibid., p. 136, pl. lviii, figs. 53\* *a, b*.

<sup>5</sup> 1892, Whiteaves, 'Cont. Canad. Pal.,' vol. i, pt. 4, p. 310, pl. iv, fig. 7.

<sup>6</sup> 1832, Goldfuss, in De la Beche's 'Handbuch,' p. 531.

<sup>7</sup> 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 17, p. 289, pl. xxvi, figs. 10, 11.

<sup>8</sup> 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 278, pl. clix, fig. 11.

<sup>9</sup> 1836, Phillips, 'Geol. Yorks.,' vol. ii, p. 209, pl. v, fig. 5.

1. EDMONDIA BODANA, *F. A. Römer*, sp. Plate IX, figs. 5?, 8.

1860. CARDINIA BODANA, *F. A. Römer*. Beitr. Harzgeb., pt. 4, p. 163, pl. xxv, figs. 15 a, b.
1862. EDMONDIA BURLINGTONENSIS, *White and Whitfield*. Proc. Bost. Soc. Nat. Hist., vol. viii, p. 301.
1884. CARDINIA? BODANA, *Clarke*. Neues Jahrb. f. Min., Beil.-Band. iii, p. 379.
1883. EDMONDIA BURLINGTONENSIS, *Hall*. Pal. N. Y., vol. v, pt. 1, pl. lxiv, figs. 19—29.
1885. — — — *Hall*. Ibid., pt. 1, No. 2, p. 390, pl. lxiv, fig. 22, and pl. xcv, figs. 13, 14.
- ? 1885. — SUBOVATA, *Hall*. Ibid., p. 389, pl. lxiv, figs. 10, 18—21, 27, 28, and pl. xcv, figs. 9—12.

*Description*.—Shell rather small, transversely oval, rather strongly convex. Hinge-line unseen, but apparently about two-thirds the length. Anterior and posterior margins roundly and evenly convex, slightly oblique. Inferior margin long, slightly convex. Umbo apparently prominent, broad, rounded, and incurved, situated at about the anterior fourth of the length. Lunule undefined. Contour convex vertically, nearly flat transversely on the back, convex posteriorly. Surface with about ten irregular undulations of growth, covered by numerous finer lines, the ornament continuing strong on the posterior slope.

*Size*.—Length 19 mm., height 12 mm., depth of one valve 4 mm.

*Localities*.—In the Barnstaple Athenæum is one example from Kingdon's, Shirwell, and one from Sloly; in the Museum of Practical Geology one from Braunton, and one from West Angle Bay, Pembrokeshire; in the Porter Collection one from Roborough.

*Remarks*.—The species seems distinguished by its almost regularly oval shape, slight transverseness, comparative smoothness, and the absence of any posterior angle on the back.

Our figured specimen appears exactly similar to *F. A. Römer's* figure of his *Cardinia Bodana*, except that it is very slightly more transverse.

It also seems perfectly like *E. Burlingtonensis*, *White and Whitfield*, with which *Hall* at first associated shells which he afterwards separated as *E. subovata*, *Hall*, but which present so close a resemblance that it is hard to trace in his various figures the slight differences which he points out.

*Affinities*.—*E. unioniformis*, *Phillips*, sp.,<sup>1</sup> which is *de Koninck's* type of the genus, differs in being more circular.

*Leptodomus semisulcata*, *Sowerby*, sp., as given by *Phillips*,<sup>2</sup> is more ovate,

<sup>1</sup> 1836, *Phillips*, 'Geol. Yorks.', vol. ii, p. 209, pl. v, fig. 18.

<sup>2</sup> 1841, *Phillips*, 'Pal. Foss.', p. 36, pl. xvii, figs. 57 a—c.

and more swollen behind, and has more definite, divaricating ribs, and a distinct anterior dorsal constriction.

*Sanguinolites mimus* is longer, more regularly and coarsely ribbed, and has a definitely depressed posterior slope.

*Sphenotus Hicksii*, n. sp., is longer and less regularly oval, has a more depressed back, a post-umbonal keel, and a depressed posterior slope.

## 2. EDMONDIA? ATHENÆ, n. sp. Plate IX, fig. 3.

*Description*.—Shell very small, transversely oval, moderately convex. Umbo small, low, proximate, situated at about the anterior third of the length. Anterior margin apparently deeply convex. Inferior margin long, nearly straight. Posterior margin deeply convex. Back transversely flattened. Surface with about eight or ten strong, regular, elevated, rounded, concentric ridges, separated by similar depressions.

*Size*.—Height 5 mm., length 8 mm.

*Locality*.—One specimen from Bradiford is in the Barnstaple Athenæum.

*Remarks*.—The only specimen of this shell that I know is very poor, but it seems to be distinguished from accompanying species by its transverse oval form, and its very strong, sharpish, regular striæ. On the same slab are several specimens of *Cypricardinia scalaris*, but it does not seem possible that it could have affinity to that rather variable species.

It approaches in shape, and agrees in ornament with, several of the numerous Carboniferous species referred by de Koninck to this genus.

It is so similar in general appearance to *Sanguinolites Unger*, F. A. Römer,<sup>1</sup> that for a long time I thought it belonged to that species; but F. Römer shows that shell to be congeneric with his *Venulites concentricus*,<sup>2</sup> and a Belgian specimen in the Woodwardian Museum shows the latter species to be widely removed, and more in the style of an *Astarte*. The shell given by Kayser<sup>3</sup> as *Allorisma Unger*, F. A. Römer, sp., differs in having finer and much more numerous striations.

<sup>1</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 26, pl. vi, figs. 26 a, b.

<sup>2</sup> 1844, Ferd. Römer, 'Rhein. Uebergangsgeb.,' p. 79, pl. ii, figs. 3 a—c.

<sup>3</sup> 1878, Kayser, 'Abhandl. Geol. Specialk. Preuss.,' Band ii, pt. 4, p. 118, pl. xx, fig. 7.



## 3. EDMONDIA? HAMLINGII, n. sp. Plate XI, fig. 3.

*Description*.—Shell large, transverse, sub-equilateral, very convex. Umbo large, rounded, incurved, direct, extending above the hinge-line, and situated a little in front of the centre. Anterior and posterior margins evenly and deeply convex, the latter being the broader. Inferior margin long, gently convex. Hinge-line shorter than the length of shell. Contour of back evenly convex. Surface covered with very numerous, fine, irregular growth-lines.

*Size*.—Height 23 mm., length 32 mm., depth of valve about 10 mm.

*Locality*.—One specimen is in Mr. Hamling's Collection, in a pebble from the beach at Saunton Point.

*Remarks*.—The umbo and hinge of this fine specimen are obscured by the hard gritty matrix, and it is impossible to decide its exact generic position. It appears far removed from any of the other species of our beds, being marked by its remarkably regular, convex, oval form, and the central position of its umbo. As it bears most general resemblance to some species of *Edmondia* described by de Koninck, it seems best to refer it provisionally to that genus. In the same pebble, specimens of *Strophalosia productoides*, *Athyris concentrica*, and *Orthis interlineata* occur.

*Affinities*.—It seems to have a larger umbo than *E. orbitosa*, de Ryckholt<sup>1</sup> and *E. prælata*, de Roninck.<sup>2</sup>

## 4. Genus—SPHENOTUS, Hall, 1885.

Shell equivalve, very unequilateral, elongate, sub-trapezoidal. Anterior end short. Posterior end obliquely truncate. Beaks sub-anterior. Hinge-line long, nearly straight. Umbonal ridge defined. Postero-superior slope marked characteristically with a median ridge. Back with a broad median depression, sometimes producing a constriction in the margin. Surface concentrically striated. Hinge narrow, with two short narrow central teeth in right valve, and two extremely slender lateral teeth. Ligamental groove slender, external. Anterior muscle-scar strong, marginal. Posterior scar shallow. Pallial line simple.

The above description is condensed from Hall, who states that the genus differs from *Sanguinolites* and *Allorisma* by its umbonal and post-cardinal ridges, its trapezoidal shape, its central cincture, and the character of the hinge.

Judging by the external characters, the following species appear referable to it.

<sup>1</sup> 1885, de Koninck, 'Ann. Mus. Roy. H. N. Belg.', vol. xi, p. 36, pl. xiii, figs. 18—26.

<sup>2</sup> Ibid., p. 36, pl. xiii, figs. 26, 27.

## 1. SPHENOTUS HICKSII, n. sp. Plate IX, fig. 9.

1841. PULLASTRA? COMPLANATA, *Phillips* (not *Sowerby*). Pal. Foss., p. 35,  
pl. xvii, fig. 56.

*Description*.—Shell rather small, convex, transverse, subquadrate. Hinge-margin with two long, transverse, lateral teeth. Umbo prominent, wide, flattened, incurved, anteriorly truncate, situated at about the anterior third of the length. Anterior margin rather broad, deeply convex. Inferior margin long, straight, or very slightly concave. Postero-inferior corner much produced, roundly convex. Posterior margin probably oblique. Contour of back vertically convex, transversely flattened and slightly depressed in the middle; curving rapidly in front to form an undefined lunule, which is bisected by the produced margins; bounded behind by a more or less distinct rounded angle or ridge from the umbo to the postero-inferior corner. Posterior slope obliquely flattened. Surface with ten or fifteen irregular undulations, less marked on the sides, and with a minor ornament of minute, crowded, sharpish transverse lines, only seen where the shell is well preserved. Shell-structure thin.

*Size*.—Length 25 mm., height 13 mm., depth of valve 5 mm.

*Localities*.—In the Museum of Practical Geology is a specimen from the new Ilfracombe Road near Barnstaple; in the Barnstaple Athenæum, eight from Kingdon's, Shirwell; and in the Porter Collection two from Pilton.

*Remarks*.—While these fossils clearly belong to the species described by Phillips as *Pullastra complanata*, Sowerby, they are perfectly distinct from Sowerby's own species.<sup>1</sup> The latter is a much more oblique and trigonal shell, with a very narrow anterior end, and altogether has a more mytiloid appearance, as seen by his type in the Museum of the Geological Society.

None of our specimens are very perfect, or give the full shape. The amount of depression in the back and of the transverseness seems to vary considerably.

One of Mr. Porter's specimens is a cast, and seems to show two long posterior teeth. This is not, however, very clear.

2. SPHENOTUS SOLENOIDES, *Hall*? Plate IX, figs. 10, 11.

1870. SANGUINOLITES SOLENOIDES, *Hall*. Prelim. Notice Lamell., pt. 2, p. 38.

1883. — — — *Hall*. Pal. N. Y., vol. v, pt. 1, Plates, pl. lxxv,  
figs. 21—28.

1885. SPHENOTUS SOLENOIDES, *Hall*. Ibid., vol. v, pt. 1, No. 2, p. 398, pl. lxxv,  
figs. 21—28.

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<sup>1</sup> 1839, Sowerby, in Murchison's, 'Sil. Syst.,' p. 609, pl. v, fig. 7.

*Description*.—Shell obliquely convex, very transverse, of moderate size. Umbo situated at about the anterior third of the length, small, much flattened and truncated, incurved, tending forward. Hinge-line probably nearly the length of the shell. Anterior margin produced, narrow, evenly convex. Inferior margin very long, nearly straight, slightly oblique. Posterior margin broad, gently convex. Contour of back gently convex on the line of greatest depth from umbo to postero-inferior corner, in front of which it is obliquely flat, and behind which it is gently convex. Surface with a few rather irregular and divaricating, rounded growth-ridges on the back, which almost vanish on and behind the aforesaid line.

*Size*.—Height 10 mm., length 24 mm.

*Locality*.—There are three specimens from "the top of the Baggy Stage," S.W. of Sloly, in the Woodwardian Museum.

*Remarks*.—These shells are very indistinct, but they appear so closely to correspond with the figures given by Hall of his *Sphenotus solenoides*, that there seems great probability that they are identical. Our best preserved specimen (fig. 10) appears still more transverse, but this is evidently due to the squeezing to which the beds have been so much subjected, and possibly the greater flattening and depression of its umbo may be due to the same cause. The posterior ridge or keel seems sharper in the American shell, and the inferior margin sometimes slightly concave.

### 3. SPHENOTUS? SOLENIFORMIS, *Goldfuss*, sp. Plate XII, figs. 1, 1 a.

1834-40. SANGUINOLARIA SOLENIFORMIS, *Goldfuss*. Petref. Germ., vol. ii, p. 277, pl. cliii, fig. 7.

1895. SPHENOTUS SOLENIFORMIS, *Beushausen*. Abhandl. k. Preuss. Landes., n. s., pt. 17, p. 215, fig. 19; and pl. xviii, figs. 1, 2.

*Description*.—Shell (cast) rather large, extremely transverse, subconvex, quadrate. Umbo flattened, adpressed, proximate, curved forward, and situated at about the anterior tenth of the length. Hinge-line straight, about five-sixths the length of shell. Anterior margin probably sloping obliquely from umbo to the anterior angle, which is one-third way down, and then becoming obliquely convex. Inferior margin very long, direct, straight. Postero-inferior corner rather produced, apparently deeply convex. Posterior margin very short, slightly convex and oblique. Contour of back rounded in front, slightly concave beneath umbo, and with a blunt keel running from behind umbo in a slight curve to postero-inferior corner. Posterior slope flat and oblique, and marked with a few strong



unequal growth-ridges. Anterior muscle-scar apparently large, and occupying the anterior corner. Posterior muscle-scar large, circular, and indistinct, and situated below the end of hinge-line on the posterior slope. Escutcheon very long, narrow, and apparently concave and defined.

*Size*.—Height 16 mm., length 52 mm., depth of the closed shell 12 mm.

*Locality*.—There is a specimen in the Mantell Collection in the British Museum without a locality, but resembling in the mineral character the fossils of the Marwood *Cucullæa* beds.

*Remarks*.—The only specimen of this shell, though very remarkable in form, is so badly preserved that it is very difficult to say what it is. The hind margin is gaping, but the front is so much worn away that its true shape is doubtful. It appears to me very closely to resemble the figure which Beushausen gives in the text of his latest work as the undistorted form of Goldfuss's *Sanguinolaria soleniformis*. This, as far as can be judged, chiefly differs from ours in being slightly shorter, and slightly less concave in the post-umbonal slope, and in having a rather longer front margin; differences probably due to the German fossil having the shell. Whether Beushausen is right in identifying his shell with Goldfuss's, which is totally different in appearance, I have no means of judging, but if he is, it seems clear that our fossil may also be referred to it.

Beushausen places his shell under *Sphenotus*, with which it appears agreeable except in its extreme length. Our specimen has so much the appearance of straight-hinged species of Hall's genus *Cimitaria* (regarded by Beushausen as a synonym of *Leptodomus*, to which it is at all events allied), that it is quite possible it may prove to belong to it, but that cannot be ascertained till a specimen showing the true shape of its front side be found.

## 5. Genus—PTHONIA, Hall, 1870.

### 1. PTHONIA, sp. Plate IX, fig. 19.

? 1895. PTHONIA, cf. CYLINDRICA, Kayser. Ann. Soc. Géol. Belg., vol. xxii, p. 201, pl. i, fig. 9.

*Description*.—Shell small, convex, extremely transverse (umbo and anterior parts unknown). Upper and inferior margins very long, straight, and nearly parallel. Posterior margin roundly and evenly convex. Contour of back straight horizontally, roundly convex vertically. Surface with a few unequal, indistinct, transverse striæ.

*Size*.—Length more than 17 mm., height 6 mm., depth of valve 2 mm.

*Localities.*—A single specimen from Top Orchard is in the Barnstaple Athenæum, its mould being in the Porter Collection.

*Remarks.*—Though this specimen is so imperfect that its full shape, &c., cannot be ascertained, I have figured it, as it does not seem at all in accord with any of our other fossils. Its extreme elongation and the uniformity of its contour is remarkable, even if partially induced, as is indicated by a specimen of *Orthis interlineata*, Sow., on the same slab being slightly distorted in the same direction. The nearest approach to it is the shell recently described by Dr. Kayser, from Belgium, under the name *Phthonia*, cf. *cylindrica*, Hall,<sup>1</sup> which is so like that it may perhaps prove identical. From Hall's own species the differences are greater.

A fragmentary shell, from South Petherwyn, in the Museum of Practical Geology has nearly the same dimensions, but differs so much in detail as evidently to be distinct.

### III. *Family*—PROTHYRIDÆ, S. A. Miller, 1889.

#### 1. *Genus*—PROTHYRIS, Meek, 1869.

Shell equivalve, very inequilateral and transverse, moderately convex, concentrically striated, gaping and rectangularly notched in front, close or slightly gaping behind; umbo depressed, subterminal, with a small (elevated) fold running from it to the anterior notch; inferior margin direct, convex or re-curved.

There seems one discrepancy between the genus as generally defined, and the characters shown by English species, viz. that the notch in the latter is the termination of an elevated ridge running from the umbo, and not of a groove, as appears indicated by Meek, Hall, Zittel, Fischer, &c. Whether this points to a real difference I cannot say, but the character of the ridge in the English shells is clear.

The species appear to be gregarious.

#### 1. PROTHYRIS RECTA, n. sp. Plate IX, figs. 12—14.

*Description.*—Shell rather small, transverse, slightly convex. Umbo low, incurved, situated at about the anterior third of the length, inclined forward. Hinge-margin long (details unknown). Anterior margin broad, roundly convex, with a small triangular notch or nick at its centre. Inferior margin long, very slightly convex. Postero-inferior corner produced, narrow, very convex. Posterior margin nearly straight, very oblique. Surface with unequal, low,

<sup>1</sup> 1885, Hall, 'Pal. N. Y.', vol. v, pt. 1, No. 2, p. 473, pl. lxxviii, figs. 1—4.

convex growth-swellings, separated by deep impressed lines, and apparently covered with finer lineations, and with one or two impressed rays on the postero-superior slope. Contour flattish on the back, steeply convex on the supero-posterior part, where a narrow groove runs from the rear of the umbo to the margin, and broken in front by an arching ridge running from before the umbo to the anterior marginal nick, and defining a lunule. Shell-structure massive. Pallial line at some distance from the margin. Posterior muscle-scar apparently small, and situated near the posterior point. Anterior muscle-scar near the umbo. Interior of the shell with grooves and pits.

*Size*.—Height 12 mm., length 18 mm., depth of one valve about 3 mm.

*Localities*.—There are twenty-six specimens in the Museum of Practical Geology from Baggy Point, "South Cave," and "just over the grits" in blackish Limestone.

*Remarks*.—Though these shells were evidently common in their locality, it has been difficult to find sufficiently perfect specimens to define the species, especially as it seems to have been rather variable in shape.

*Affinities*.—It differs from *Prothyris contorta* in being shorter and less oblique, and in having a convex base.

## 2. PROTHYRIS CONTORTA, n. sp. Plate IX, figs. 15, 16, 16a.

*Description*.—Shell small, convex, subquadrate, very transverse. Hinge-line unseen, but apparently about half the length of the shell. Umbo small, low, oblique, flattened, and situate near the anterior end. Anterior margin very convex, but broken at about its centre by a small, deep, concave notch, which is the termination of a rounded elevated conical ridge, running to it from the front of the umbo. Inferior margin very long, convex in front, straight or even slightly concave in the median region, becoming convex behind. Postero-inferior corner produced and very deeply convex. Posterior margin oblique above. Contour of back very evenly convex except for the tubular ridge. Cast marked with one or two deep linear furrows running along the postero-superior edge, and with a triangular perpendicular clavicular groove under the umbo. Muscle-marks *apparently* large and not marginal. Pallial sinus *apparently* deeply indented. Surface covered with very numerous microscopic, impressed, concentric striæ, and having five or six fine sharp sub-parallel ridges running along the postero-superior side of the shell immediately below the hinge-margin. Shell-structure rather thick for the size of the shell.



*Size*.—Height 8 mm., length 22 mm., depth of one valve 2 mm. (approximately).

*Locality*.—There are several small specimens in the Barnstaple Athenæum from Kingdon's, Shirwell, and two or three in the Porter Collection from Pilton.

*Remarks*.—While in many respects good, the specimens leave much that is doubtful about this species. It seems to be distinguished by its very long subquadrate or rhomboidal shape and slightly sigmoid inferior margin.

3. *PROTHYRIS SCALPRATA*, n. sp. Plate IX, figs. 17, 18, 18 *a*; and (?) Plate X, figs. 16—17 *a*.

*Description*.—Shell small, equivalve, gently convex, lancet-shaped, very transverse. Umbo wide, low, proximate, slightly rounded, very oblique, arching forward, concavely truncate in front. Anterior margin produced, broad, very convex, but suddenly and deeply notched at the medio-anterior point, below which it immediately curves with a slight convexity into the inferior margin. Inferior margin very long, and gently and evenly convex. Posterior side long and narrow. Posterior margin produced to an almost sharp median angle, with similar gently convex sides; the upper side becoming slightly concave as it meets the end of the hinge-margin rather behind the middle line of the shell. Hinge-margin straight, about half the length of the shell. Hinge with three or four long, linear, parallel (or radiating), transverse, posterior lateral teeth. Lunule deep, ovate, defined by a raised tubular ridge, which arches from the umbo to the notch in the anterior margin. Contour of back vertically gently convex, horizontally nearly flat, obliquely truncated in the extreme supero-posterior part, concave in the antero-superior part or lunule, and broken by the squarish conical arching ridge running from the front of the umbo to the anterior notch. Surface ornamented with distant impressed striæ or growth-lines, especially near the margins, and with two or three slight sunken radiating threads on the postero-superior part of the shell.

*Size*.—Length 16 mm., height 7 mm., depth 3 mm.

*Localities*.—There is a specimen (of the open valves) from Croyde, and another from the Sloly beds of Plaistow Mill Quarry, near Barnstaple, in the Museum of Practical Geology; there are numerous specimens from Sloly in the Barnstaple Athenæum, from S.W. of Sloly in the Woodwardian Museum, and from the Sloly Quarry in my Collection.

*Remarks*.—This species, though rarely found in at all good preservation, is evidently an abundant and characteristic fossil of the Sloly beds. In the Sloly Quarry Dr. Hicks and I observed a bed near the *Lingula squamiformis* bed which

is absolutely covered with their crowded valves, though so decayed and often so distorted that they cannot be individually recognised, and it is only by means of an occasionally better preserved specimen that the species can be made out. The totally different appearance sometimes produced by the extreme distortion is illustrated by the two figures on Pl. X, which were not recognised as the present species till long after they were drawn.

*Affinities.*—From the two accompanying species of this genus the present shell is at once distinguished by its long lancet-like shape and its angular posterior side. It appears confined to the Sloly beds, while the other two occur higher in the series, the one near the base, and the other in the middle of the Pilton beds.

It is something like *Ctenodonta tumida*, Sandberger,<sup>1</sup> in general shape, but is totally different in detail.

## 2. ORDER—HOMOMYARIA, Zittel, 1881.

### I. *Family*—UNICARDIIDÆ, Fischer, 1887.

#### 1. *Genus*—SCALDIA, de Ryckholt, 1847.

I have placed the following species under this genus as being possibly in accord with it, but sufficient is not known of the shell to determine its true affinities.

#### 1. SCALDIA? LONGA, n. sp. Plate X, figs. 1, 1 a, 2.

*Description.*—Shell small, transversely oval, very convex. Umbo nearly central, prominent, slightly arching forward. Anterior and posterior margins nearly similar and approximately semicircular. Inferior margin gently convex. Contour rather flat transversely, very convex vertically, becoming concave in the superior corners. Umbonal slopes rounded. Muscle-scars extremely large, irregularly subcircular, situated on the superior side not far from the umbo. Shell-structure very thick.

*Size.*—A single valve is about 12 mm. long, 9 mm. high, 3 mm. deep.

*Locality.*—Two specimens are in the Museum of Practical Geology from South Cave, Baggy Point.

*Remarks.*—The nearly central umbones and sub-equilateral transversely oval form distinguish these little shells from any that otherwise approach them.

<sup>1</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 277, pl. xxix, figs. 6, 6 a.

They are evidently casts of a very thick shell, and show traces of a few transverse ridges of growth. In the neighbourhood of the umbo are a few prominences, indicating indented pits in the inner surface of the valve. The muscle-scars seem rounded and unusually and equally large; the anterior scar is situated halfway from the apex to the centre of the anterior margin, and the posterior scar much nearer to the centre of the posterior side.

II. *Family*—ARCTICIDÆ, *R. B. Newton*, 1891.

CYPRINIDÆ, *Gray*, 1840.

1. *Genus*—CYPRICARDINIA, *Hall*, 1859.

1. CYPRICARDINIA SCALARIS, *Phillips*, sp. Plate IX, figs. 20, 21.

1841. MODIOLA SCALARIS, *Phillips*. Pal. Foss., p. 137, pl. lx, fig. 62\*.  
 ? 1858. CYPRICARDIA IMPRESSA, In Baer and Helmersen's Beitr. Russ. Reiches,  
 Band xxi, p. 106, pl. iv, figs. 4 a, b.  
 1892. CYPRICARDINIA SCALARIS, *Whidborne*. Dev. Faun., vol. ii, p. 5, pl. i,  
 figs. 6—8.  
 ? 1894. — SANDBERGERI, *Holzappel*. Abhandl. k. Preuss. Geol.  
 Landes., n. s., pt. 16, p. 181, pl. xvi, fig. 3.  
 1895. — LIMA (*Schnur*), *Beushausen*. Ibid., n. s., pt. 17, p. 182,  
 pl. xvi, fig. 1.  
 1895. — SCALARIS, *Beushausen*. Ibid., p. 179, pl. xvi, fig. 2.  
 ? 1895. — SANDBERGERI, *Beushausen*. Ibid., p. 181, pl. xvi, fig. 3.

*Localities*.—In the Barnstaple Athenæum are two specimens on a slab from Bradiford and one from Top Orchard; in the Porter Collection two from Pilton; and in my Collection six from the lane between Wrafton and Heanton.

*Remarks*.—After comparing these with specimens from Lummaton I feel no doubt that they belong to Phillips's species. As their surface is often much decayed, their markings are not always so definite, but their character seems the same, and their shape varies within the same limits. They seem still smaller in size.

I much regret that I am unable to follow Beushausen in separating the three species quoted above from his recent masterly work. Even if the distinctions which the learned German draws are permanent in the Continental specimens, it appears to me that they are unlikely to indicate more than local varieties. As far as I can see, English specimens might be selected which would be ranked in each of them. It would seem that it is not always the same valve which is the largest in the English species, and that the median constriction varies much in its strength.



*C. impressa*, Pacht, appears to agree in form and ribbing, but is of a much larger size.

2. CYPRICARDINIA ? sp. Plate IX, fig. 22.

*Description*.—Shell small, oblique, transverse. Anterior side much contracted, possibly subangular. Antero-inferior margin rather long, oblique. Inferior margin moderately short, very slightly convex. Postero-inferior corner rounded, very convex. Hinge-margin about three-quarters (?) of the length. Umbo broad, flat, prominent, curving forward, and situate anteriorly. Contour of back flattened horizontally between lines of curvature which run from the umbo to the lower part of the sides. Surface covered by about twenty large, broad, low, subangular, concentric ridges, apparently marked with minute crenulations.

*Size*.—13 mm. long, 9 mm. wide.

*Localities*.—A specimen from Sloly is in the Barnstaple Athenæum.

*Remarks*.—This specimen is very obscure. It has every appearance of belonging to the genus *Cypricardinia*, though there seems no positive evidence that it does so.

3. CYPRICARDINIA, sp.

*Description*.—Shell minute, suborbicular, very convex, oblique. Umbo elevated, prominent, incurved, direct, anterior. Anterior margin narrow, apparently nearly straight. Inferior margin oblique, slightly convex. Postero-inferior corner subangular, produced. Posterior margin long, oblique, slightly convex. (Hinge-margin unseen, perhaps half the length of shell.) Lunule apparently deep and undefined. Contour very convex, divided by a blunt angle from umbo to postero-inferior corner, behind which it is flatter and steeper. Surface covered with numerous strong parallel ridges on the back.

*Size*.—About 2 mm. long, 1.5 mm. high, and .5 deep.

*Locality*.—A single specimen from Marwood is in the Barnstaple Athenæum.

*Remarks*.—This tiny shell seemed too indistinct for figuring, but by a minute examination many of its details have become evident. It reminds one strongly of the general form of *Opis*, but no doubt is really a species of *Cypricardinia*.

*Affinities*.—It differs from *C. scalaris* by its shortness, convexity, and much finer striation, in the last point coming nearer the species last described.

III. *Family*—TRIGONIIDÆ, *Fleming*, 1828.1. *Genus*—MYOPHORIA, *Bronn*, 1835.

Salter established the genus *Curtonotus*, and Neumayer *Kefersteinia*, for shells which are similar or identical with Devonian species referred to *Schizodus*, but which are shown by Beushausen to be included within the limits of *Myophoria*.

1. MYOPHORIA INFLATA, *F. A. Römer*, sp. Plate X, figs. 3, 3 a, 4, 4 a.

1843. *TELLINA INFLATA*, *F. A. Römer*. Verst. Harzgeb., p. 28, pl. vi, fig. 22.  
 ? 1844. *AXINUS NUCULOIDES*, *M'Coy*. Syn. Carb. Ireland, p. 63, pl. xi, fig. 9.  
 1849. *CARDINIA INFLATA*, *d'Orbigny*. Prodrome, vol. i, p. 76.  
 1855. — — *F. A. Römer*. Beitr. Harzgeb., pt. 3, p. 13, pl. iii, fig. 12.  
 1855. — *TRAPEZOIDALIS*, *F. A. Römer*. Ibid., p. 13, pl. iii, fig. 11.  
 1857. *SCHIZODUS INFLATUS*, *Keferstein*. Zeitsch. Deutsch. Geol. Gesell., vol. ix, p. 153, pl. iv, figs. 1—3.  
 1884. — — *Beushausen*. Abhandl. Geol. Specialk. Preuss., vol. vi, pt. 1, p. 99, pl. vi, fig. 6.  
 1884. — *KEFERSTEINI*, *Beushausen*. Ibid., p. 100, pl. v, fig. 13.  
 1884. — *TRAPEZOIDALIS*, *Beushausen*. Ibid., p. 101, pl. vi, fig. 9.  
 1895. *MYOPHORIA INFLATA*, *Beushausen*. Abhandl. k. Preuss. Geol. Landes., n. s., vol. xvii, p. 122, pl. ix, figs. 6, 7.  
 1895. — cf. *INFLATA*, *Beushausen*. Ibid., p. 123, pl. ix, figs. 8—10.

*Description*.—Cast moderate in size, almond-shaped, transverse. Umbo rounded, inclined slightly forward, situated behind the anterior third. Hinge-line long, large, gently convex. Hinge-teeth large, broad, oblique. Anterior margin broad, very convex. Inferior margin long, slightly convex. Posterior corner produced, narrow, subangular. Postero-superior margin long, oblique. Contour of back convex, becoming steeper in front, obliquely flattened in the postero-superior part, sometimes with two indistinct rounded angles on the cast, which radiate to the infero-posterior region. Anterior muscle-scar large, angular, deep, situated near the umbo; posterior scar more elongate and less distinct. Shell massive.

*Size*.—Height 19 mm., length 26 mm., depth of one valve 9 mm.

*Localities*.—Three specimens are in the Museum of Practical Geology from county Cork, and five poor and doubtful specimens in the Woodwardian Museum from west of Saunton Court.

*Remarks.*—It is very doubtful whether this shell should be included in our list, the five Devonshire specimens being so poor as to be almost undecipherable. The shells figured appear to belong to the Infra-carboniferous of Ireland.

Keferstein united *Tellina* or *Cardinia inflata*, F. A. Römer, with *C. trapezoidalis*, F. A. Römer. These Beushausen in 1884 again separated into three species, calling Keferstein's *Sch. inflatus* by the name *Sch. Kefersteini*. It appears to me that Beushausen's figure of *Sch. Kefersteini* is almost exactly like Römer's figure of *C. trapezoidalis* and Römer's first figure of *T. inflata*, while his figure of *Sch. inflata* seems more like Römer's second figure and Keferstein's. To the latter of these one of our specimens is very similar; and a second, which is not figured, equally resembles the former. Our own material was insufficient to prove anything, but as other species of the genus are evidently liable to much variation, I was led to the conclusion that the balance of probability was on the side of Keferstein's view. It is interesting, therefore, to find that in his later work Beushausen has reversed his former judgment, and reunited all three as *M. inflata*, though at the same time adding another form, which seems to me also to be identical.

*Axinus nuculoides*, M'Coy, though much smaller, may perhaps be the young or a dwarfed variety of the same species.

## 2. MYOPHORIA DELTOIDEA, *Phillips*, sp. Plate X, figs. 5—8.

- 1841. CYPRICARDIA DELTOIDEA, *Phillips*. Pal. Foss., p. 37, pl. xvii, fig. 59.
- 1842. NUCULITES CHEMUNGENSIS, *Conrad*. Journ. Acad. Nat. Sci. Philad., vol. viii, p. 247, pl. xiii, fig. 13.
- 1842. — ADPRESSA, *Conrad*. Ibid., p. 248, pl. xv, fig. 4.
- ? 1843. CYPRICARDIA ? RHOMBEA, *Hall*. Geol. Surv. N. Y., Rept. 4th Dist., p. 291, pl. cxxxix, figs. 2, 3.
- ? 1844. AXINUS ORBICULARIS, *M'Coy*. Syn. Carb. Foss. Ireland, p. 64, pl. viii, fig. 28.
- 1844. — DELTOIDEUS, *M'Coy*. Ibid., p. 63.
- 1855. ANODONTOPSIS DELTOIDEUS, *M'Coy*. Brit. Pal. Foss., p. 396.
- ? 1863. CURTONOTUS ELEGANS, *Salter*. Quart. Journ. Geol. Soc., vol. xix, p. 495, figs. 3 a, b.
- 1870. SCHIZODUS ADPRESSUS, *Hall*. Prelim. Notice Lamell., pt. 2, p. 95.
- ? 1870. — RHOMBEUS, *Hall*. Ibid., p. 95.
- 1883. CYTHERODON ADPRESSUS, *Hall*. Pal. N. Y., vol. v, pt. 1, plates, pl. lxxv, figs. 3—9.
- ? 1883. — RHOMBEUS, *Hall*. Ibid., figs. 19—23.
- 1883. — QUADRANGULARIS, *Hall*. Ibid., figs. 31—36.
- 1883. — CHEMUNGENSIS, *Hall*. Ibid., figs. 37—40.



1885. SCHIZODUS ADPRESSUS, *Hall.* Pal. N. Y., vol. v, pt. 1, No. 2, p. 449, pl. lxxv, figs. 3—9.  
 ? 1885. — RHOMBEUS, *Hall.* Ibid., p. 452, pl. lxxv, figs. 19—23.  
 1885. — CHEMUNGENSIS, *Hall.* Ibid., p. 453, pl. lxxv, figs. 31—34, 36—41, 45.  
 1885. — ÆQUALIS, *Hall.* Ibid., p. 458, pl. lxxv, fig. 35; and pl. xcv, fig. 29.  
 1893. CYPRICARDIA DELTOIDEA, *Collins.* Trans. Roy. Geol. Soc. Cornwall, vol. xi, p. 36.  
 1893. SCHIZODUS DELTOIDEUS, *Collins.* Ibid., p. 38.

*Description.*—Shell moderate in size, convex, slightly transverse, subquadrate. Umbo small, direct, incurved, slightly truncate behind, and situate rather in front of the centre. Hinge-margin short, convex. Hinge containing a large, triangular central tooth, and a smaller, more elongate, and indistinct posterior tooth. Anterior margin broad and roundly convex. Inferior margin rather long, slightly convex. Postero-inferior corner rather produced and subangular. Posterior margin oblique and slightly convex. Contour of back divided by a blunt angle running from the umbo to the postero-inferior point, in front of which it is transversely flat, becoming convex in front, and behind which it is oblique and flat. Posterior muscle-scar high up near the centre of the posterior hinge-margin.

*Size.*—Height 16 mm., length 20 mm., depth of one valve 5 mm.

*Localities.*—In the Museum of Practical Geology are two specimens from Marwood, six from Shirwell, one from Petherwyn, and one from West Angle Bay, Pembrokeshire. In the Porter Collection is one from Marwood; in the Woodwardian one from Marwood and two very obscure specimens from Baggy Point.

*Remarks.*—The Petherwyn specimen almost exactly agrees with Phillips's figure, the only difference being that it is perhaps slightly more transverse. Being in the Museum which contains so many of his figured specimens, it is probable that it is the original type of his *Cypricardia deltoidea*, and it is to be observed that Phillips noted its resemblance to *Axinus*.

Mr. Coy states it to be not uncommon in the sandstones of Baggy Point, and it seems probable that the beds to which he refers are those which have contributed eight specimens from Shirwell and Marwood to the same museum. The first question, therefore, is whether these specimens can be identified with the type. They differ at first sight in being flatter and in having a less prominent umbo, above which the hinge is seen, whereas it is invisible in the type specimen. At this point Mr. Porter's specimen may be noted as uniting them in shape, and partially showing the teeth. These Marwood specimens are, indeed, of all shapes, long and high, but this is probably largely due to fossilisation, or at least to similar causes to that which produced such variations in the specimens of *Cucullæa* and *Avicula* of the same

beds. It is also to be observed that one of them so exactly resembles *Curtonotus elegans*, Salter, as to render it very probable that it is only a variety of the same species.

We next come to some American forms which are strikingly like our supposed type-specimen, but which appear generally to differ from our fossils by having more elevated umbones. This seems probably to be due to the American fossils retaining their shells, while our specimens are all in the nature of casts.

*Schizodus quadrangularis*, Hall, and *Sch. Chemungensis*, Conrad, appear identical with each other and with the present shell, except that they are about half as large again—a fact which could hardly give them more than varietal rank, as both the English and American shells vary considerably in size. *Schizodus adpressus*, Conrad, is regarded by Hall as “probably only a variety of *Sch. Chemungensis* which lived under different conditions.” *Sch. æqualis*, Hall, is separated by him from *Sch. Chemungensis*, var. *quadrangularis*, as having “the base more broadly rounded and the anterior portion more expanded below;” but, if he be correct in making the latter form a variety of *Sch. Chemungensis*, it is difficult to see why the former also should not be included in it, and that form is approached by the specimen from West Angle. As given by Whiteaves,<sup>1</sup> however, *Sch. Chemungensis* is wider and more rounded.

On the whole there seems reason for regarding these various forms as not more than varieties of one variable species.

*Schizodus rhombeus*, Hall, may also possibly be a variety; but, though equalling the English shells in size, it seems essentially to differ from the adjacent forms in being longer, and in having less anterior inflation.

*Axinus orbicularis*, M'Coy, has much the appearance of being the young or dwarfed form.

*Affinities*.—*C. centralis*, Salter,<sup>2</sup> seems distinguishable by its larger and more terminal muscle-scars, its more central umbo, and its more oval form, without signs of posterior truncation.

*Schizodus obrotundatus*, Beushausen,<sup>3</sup> appears to have a slightly larger hinge, and not to be flattened and angulated on the posterior side.

*Axinus obliquus*, M'Coy,<sup>4</sup> seems to have a much less inflated anterior side.

<sup>1</sup> 1891, Whiteaves, 'Contr. Canad. Pal.,' vol. i, pt. 3, p. 241, pl. xxx, figs. 5, 5 a.

<sup>2</sup> 1863, Salter, 'Quart. Journ. Geol. Soc.,' vol. xix, p. 495, figs. 4 a, b.

<sup>3</sup> 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 1, p. 95, pl. vi, figs. 7, 8.

<sup>4</sup> 1844, M'Coy, 'Syn. Carb. Foss. Ireland,' p. 64, pl. v, fig. 29.





long. In the Porter Collection, however, are two specimens which seem to be specifically identical, and which show that its outline was sometimes more circular, and in the young form more transverse and trigonal. Comparing these Devonshire specimens with *Curtonotus unio*, Salter,<sup>1</sup> which occurs in profusion at West Angle Bay, Pembrokeshire, it appears that they are closely allied, and possibly only varieties of the same species. My Pembrokeshire specimens are unfortunately all defective, it being impossible to extricate them from the hard, crystalline, purple limestone in which they are embedded, but they appear to be very similar in shape, except that they are usually more transverse and quadrate than the Devonshire specimens. It is, however, clear that they themselves varied very considerably in relative measurements.

Turning next to foreign specimens, we find that Keferstein's figure of *Schizodus trigonus* exactly agrees with our Woodwardian specimen, except that it is not quite so high. This shell he identifies with *Thetis* (?) *trigona*, F. A. Römer, which is smaller, and much more transverse and trigonal, and appears exceedingly like the smaller of Mr. Porter's two specimens. If this identification by Keferstein is correct, there seems no reason against regarding all the above-mentioned English shells as equally belonging to the same species.

*Affinities*.—*Schizodus ovalis*, Keferstein,<sup>2</sup> differs in being more perfectly oval; and, according to Beushausen,<sup>3</sup> it has strong concentric striæ.

*Curtonotus elongatus*, Salter,<sup>4</sup> is a very high form. Not having seen any specimens of it, I am not certain whether his figures represent undistorted shells, but, if so, they appear specifically distinct in outline, being long and straight behind the umbo and deeply convex below.

#### IV. *Family*—NUCULIDÆ, *d'Orbigny*, 1843.

##### 1. *Genus*—NUCULA, *Lamarck*, 1801.

##### 1. NUCULA LINEATA, *Phillips*. Plate X, figs. 13, 14.

1841. NUCULA LINEATA, *Phillips*. Pal. Foss., p. 39, pl. xviii, figs. 64 *a*—*d*,  
β *a*, *b*.

<sup>1</sup> 1863, Salter, 'Quart. Journ. Geol. Soc.,' vol. xix, p. 495.

<sup>2</sup> 1857, Keferstein, 'Zeitsch. Deutsch. Geol. Gesell.,' vol. ix, p. 155, pl. iv, fig. 6.

<sup>3</sup> 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes., n. s., pt. 17, p. 119, pl. x, figs. 15, 16.

<sup>4</sup> 1863, Salter, 'Quart. Journ. Geol. Soc.,' vol. xix, p. 496, figs. 5 *a*—*d*.

1863. *NUCULA LINEATA*, *Semenow and Möller*. *Mélange Phys. et Chim.*, vol. v,  
p. 678, pl. iv, fig. 11.
- ? 1868. — *PLICATA*, *Dames*. *Zeitsch. Deutsch. Geol. Gesell.*, vol. xx,  
p. 502, pl. x, figs. 8 *a, b*.

*Description*.—Shell small, subtriangular, oblique, very convex. Umbo large, prominent, elevated, rounded, situated at or about the posterior third of the length, and tending somewhat backward. Hinge-line convex, about half the length of the shell, and ending abruptly at the sides, bearing a fossette and a few very minute teeth under the umbo, about four large, high, perpendicular, parallel, posterior lateral teeth, and about six still larger and loftier, perpendicular, parallel, anterior lateral teeth. Anterior margin much produced, straight and oblique above, and deeply convex round the anterior corner. Inferior margin long, gently convex. Posterior margin broad, roundly convex. Surface with ten or or twelve fine, sharp, elevated, very distant concentric ridges, between which several very fine intermediate concentric striæ are seen. Shell-structure very thick.

*Size*.—Height 5 mm., length 9 mm., depth of both valves 3 mm.

*Localities*.—In the Barnstaple Athenæum is a specimen from Upcott, and another from Brushford; in the Museum of Practical Geology one from Saunton, and another (which is very poor) from east of Ashford Inn; in the Woodwardian Museum three from west of Saunton Court; and in my collection one from Upcott Arch Quarry. Phillips records it from "Baggy Point."

*Remarks*.—From Phillips's description the species varied considerably in length, size, and sculpture. The variation in contour is seen in our specimens, which seem as a rule rather more transverse than his. Our specimens are, with one exception, casts. It seems doubtful whether the possible crenulation of the striæ mentioned by Phillips is not simply due to fracture. In casts of the double shell the impress of the lofty interlocked teeth leave a beautiful scalloped pattern, and the margins protrude sharply at the ends of the hinge-line.

## 2. *Genus*—CTENODONTA, *Salter*, 1851.

Æhlert,<sup>1</sup> who discusses the question fully, points out that *Tellinomya*, Hall, and *Ctenodonta*, Salter, having the same type species, are synonymous, and considers the latter to be the valid name.

He regards it as a genus distinguished from *Palæoneilo*, Hall, by its more

<sup>1</sup> 1888, Æhlert, 'Bull. Soc. Géol. Fr.,' ser. 3, vol. xvi, p. 653.

central and loftier umbones, its more largely rounded anterior side, the absence of a postero-superior depression, and the subrostrated shape, which is after the manner of *Leda*. On the other hand, Beushausen points out that the type species of *Ctenodonta* had a depression behind; and on the whole it is probable that *Palæoneilo*, and (Beushausen adds) *Kænenia*, should not be counted as more than groups or sub-genera of *Ctenodonta*.

1. CTENODONTA NEWTONII, n. sp. Plate X, fig. 15.

1895. CTENODONTA, sp., *Beushausen*. Abhandl. k. Preuss. Geol. Landes., n. s., pt. 17, p. 78, pl. v, fig. 23.

*Description*.—Cast small, transversely ovate, sub-equilateral. Umbo small, depressed, slightly recurved, and situated somewhat in front of the centre. Hinge-line gently bent, about two-thirds of the length, and bearing five or six very minute perpendicular teeth, uninterrupted by a fossette, under the umbo, five or six large, parallel, perpendicular anterior teeth, and about twelve large, lofty, parallel, perpendicular posterior teeth. Posterior side broad, much produced, with a deeply convex margin. Inferior margin very long, gently convex. Anterior side broader, with a more evenly convex margin. Surface covered by very numerous, regular, minute, distant, concentric striæ. Contour of back gently convex, steeper in front than behind.

*Size*.—Height 9 mm., length 12 mm., depth of the cast of one valve 2 mm.

*Localities*.—In the Barnstaple Museum are two specimens from Fremington; and in my Collection two from Frankmarsh, and a fragment from Ironpost.

*Remarks*.—These shells seem to agree in shape and ornament with the imperfect valve which Beushausen figures from the Upper Coblenzian of Sechelden.

Though our specimens are chiefly casts, evidence of the nature of the ornament is obtainable.

The species is named after R. B. Newton, F.G.S., whom I have to thank for kind assistance.

*Affinities*.—*Nucula fornicata*, Goldfuss,<sup>1</sup> is similarly marked, but is larger and deeper, and has a loftier and more lateral umbo and a fossette.

*N. lineata*, Phillips, is more convex and oblique, and has a much coarser ornamentation.

It appears to be sometimes approached by the very variable *N. domina*, Barrande,<sup>2</sup> which seems similarly ornamented.

<sup>1</sup> 1834-40, Goldfuss, Petref. Germ., vol. ii, p. 151, pl. cxxiv, figs. 5 a—c.

<sup>2</sup> 1881, Barrande, 'Syst. Sil. Bohême,' vol. vi, pl. cclxxiv, fig. 1, 5-16, Ét. D.



*N. plicata*, Phillips,<sup>1</sup> has a terminal umbo and more quadrate shape; and I expect will prove to be a *Cypricardinia*, perhaps identical with *C. scalaris*, Phillips, sp.

2. CTENODONTA (PALÆONEILO) LIRATA, *Phillips*, sp. Plate XII, figs. 12, 13, 13 *a*;  
and Plate XIII, figs. 1—4.

1841. PULLASTRA ANTIQUA, *Phillips* (not *Sowerby*). Pal. Foss., p. 35, pl. xvii, figs. 55 *a*, *b*.

1843. SANGUINOLARIA LIRATA, *Phillips*. Pal. Foss., p. 136, pl. lviii, figs. 53\* *a*, *b*.

?1884. PALÆONEILO BREVIS, *Beushausen*. Abhandl. Geol. Specialk. Preuss., Band vi, pt. 1, p. 79, pl. iii, fig. 13.

*Description*.—Shell rather small, suboval, convex, transverse, nearly twice as long as high. Umbo small, low, proximate, rather sharp, without a clavicular process, curving somewhat forward, and situated at or about the anterior third of the length. Anterior margin broad, very convex. Inferior margin long, gently convex, indented behind. Posterior margin very narrow and convex. Hinge-line nearly as long as the shell, slightly bent at the umbo, nearly straight, bearing in front of the umbo about ten small, short, obliquely vertical teeth which increase in size anteriorly, and in rear of the umbo more than thirty-seven still smaller teeth which increase in size posteriorly. Surface covered by twenty or thirty very distant, sharp, erect, very elevated threads, between which several minute minor striæ are sometimes apparent, and which are usually regular over the whole valve, but fold into each other as they curve in on the hinge-margin. Contour convex, but with a broad and shallow concave depression, between two slight convex radiating swellings, running from the rear of the umbo to the posterior end of the inferior margin. Lunule deep, ovate, undefined. Shell-structure thin. Muscular scars large, oval, situate respectively at the anterior point, and just under the posterior end of the hinge-line. Pallial line simple, rather distant from the margin.

*Size*.—A large valve from Saunton measures 29 mm. in length, 19 mm. in height, and 6 mm. in depth.

*Localities*.—In the Barnstaple Athenæum are two specimens from Saunton, four from Bradiford, two from Croyde Bay, and one from Top Orchard. In the Woodwardian Museum are two poor specimens from west of Saunton Court. In the Museum of Practical Geology are Phillips's type specimen of the species from

<sup>1</sup> 1841, Phillips, 'Pal. Foss.,' p. 38, pl. xviii, figs. 63 *a*, *b*.

Pilton, another specimen figured by Phillips as *Pullastra antiqua*, Sow., from Barnstaple, another from Croyde, a specimen of the valves in contact from "North Devon," and one showing the hinge from Baggy. In the Porter Collection are two specimens from Pilton. In my Collection are specimens from Saunton Hotel, from the *Laticosta* Beds of Baggy, from Kingdon's, Shirwell, and from Pouch Bridge.

*Remarks.*—This species is evidently one of the commoner and more widely spread bivalves of these beds, though, probably from its tenuity, the specimens are almost always defective or distorted. Examples of the extent to which this may go are to be seen from Pl. XIII, figs. 1 and 3, the transverseness of which is, I believe, entirely due to artificial elongation. The same causes also often more or less obscure the posterior depression, which seems one of the most distinctive features of the species. Under these circumstances it is extremely difficult to be certain that it is more than a variety of *Ct. antiqua*, or to define the distinguishing points if they really exist. After an examination, however, of numerous specimens, including the originals of Sowerby's and Phillip's figures, I am inclined to the opinion (1) that the two are probably distinct; (2) that they both belong to *Palæoneilo*; (3) that Sowerby's *Ct. antiqua* is to be recognised by its more evenly ovoid form, by its concentric ribs being smaller and more numerous, and by the depression on the posterior region being smaller, weaker, and not so greatly deflecting the margin; (4) that the present shell seems to be characteristic of the Pilton beds proper, while *Ct. antiqua* appears to belong to the Marwood beds; and, lastly, that the specimen Phillips figured as *Ct. antiqua*, Sowerby, sp., really belongs to *Ct. lirata* and not to *Ct. antiqua*, as it shows the same characters, especially the posterior depression, and is a Pilton, not a Marwood fossil.

The surface of some of the specimens is very well preserved, and shows four or five concentric ridges between each of the major ribs. My impression is that this may be another distinguishing mark where the fossil is sufficiently well preserved to retain it. A cast in my collection from Kingdon's shows that the interior of the shell under the umbo is a good deal pitted, but had no internal sulcus like that belonging to the kindred genus *Nuculites*. The specimens from the *Laticosta* Beds show much variation in the number and regularity of the ribs.

*Affinities.*—*Palæoneilo Rauliniana*, Rouault,<sup>1</sup> appears to differ only in having more numerous and irregular striations.

The type species of *Palæoneilo*, *P. constricta*, Conrad,<sup>2</sup> has much finer striæ than either of the Devonshire species, and is more acute behind. *P. filosa*, Conrad,<sup>3</sup> which approaches nearer in ornament, appears to be more angulated, and its striæ are more lamellar, and its posterior depression broader and flatter.

<sup>1</sup> 1888, Ehlert, 'Bull. Soc. Géol. Fr.,' ser. 3, vol. xvi, p. 650, pl. xvi, figs. 4, 4a.

<sup>2</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 333, pl. xlviii, figs. 1—20.

<sup>3</sup> 1885, Hall, *ibid.*, p. 343, pl. xlix, figs. 33—38.

Beushausen has described several species of *Palæoneilo* from the Spirifer-sandstein of the Oberharz, but being for the most part casts they are not easy to compare; *P. brevis*, Beushausen,<sup>1</sup> looks exceedingly like our specimens.

*Ctenodonta unioniformis*, Sandberger,<sup>2</sup> as given by Beushausen,<sup>3</sup> seems to approach nearly, but it is larger and more unevenly ornamented, while *Ct. gibbosa*, Goldfuss,<sup>4</sup> not Sow., sp., as given by him, seems also to be a shorter shell. I should not, however, be surprised if they both prove to be varieties of the present species.

### 3. CTENODONTA (PALÆONEILO) ANTIQUA, Sowerby, sp. Plate XIII, fig. 5.

1840. PULLASTRA ANTIQUA, Sowerby. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 28.

1855. NUCULA PULLASTRIFORMIS, M'Coy. Brit. Pal. Foss., p. 397.

1893. CTENODONTA ANTIQUA, Collins. Trans. Roy. Geol. Soc. Cornw., vol. xi, p. 36.

? 1895. — DALEIDENSIS, Beushausen. Abhandl. k. Preuss. Geol. Landes., n. s., pt. 17, p. 85, pl. vi, fig. 6.

*Description.*—Shell rather small, transversely ovate, moderately convex. Umbo small, proximate, rather prominent, incurved, tending forwards, and situated at the anterior third of the length. Hinge-margin long, straight posteriorly. Anterior margin deeply convex or subangular. Inferior margin long, gently and evenly convex. Posterior margin convex, rather broad. Contour gently convex, with a very slight and narrow posterior slope. Surface with about thirty distant, regular, elevated concentric lines.

*Size.*—Height 12 mm., length 19 mm.

*Localities.*—Six specimens from Marwood are in the Barnstaple Athenæum; one from Marwood is in the Museum of Practical Geology; and Sowerby's type from Marwood is in the Woodwardian Museum.

*Remarks.*—This species seems to characterise the Sloly Beds, and to be variable in shape, its transverseness decreasing with age.

Its name was changed by M'Coy on placing it in the genus *Nucula*, but as it belongs to *Ctenodonta* or *Palæoneilo*, it may resume its original name. The posterior depression is very narrow and indistinct, perhaps even more so than

<sup>1</sup> 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 1, p. 79, pl. iii, fig. 12.

<sup>2</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 277, pl. xxix, fig. 1.

<sup>3</sup> 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 17, p. 84, pl. vi, figs. 10—15.

<sup>4</sup> 1834–40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 278, pl. clix, fig. 10.

<sup>5</sup> 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 17, p. 83, pl. vi, fig. 16.



appears from our figure, which was carefully drawn from the very indistinct type-specimen and its cast.

*Affinities.*—From *Ct. lirata* it differs in its flatness and even contour, its smaller and plainer posterior slope, and its finer striæ.

*Ct. elliptica* is much less transverse, but the larger specimens of the present shell seem gradually to approach it, though still differing in having a narrow posterior margin, and in not having the striæ so broadly parallel to that margin.

The North Devon shell, referred to *Nuculites latissimus*, Phillips, sp., is more transverse, less ovate, less truncated behind, and more finely striated.

*Palæoneilo filosa*, Conrad,<sup>1</sup> is a narrower shell with a much wider posterior slope and finer striæ.

*Sanguinolaria gibbosa*, Goldfuss,<sup>2</sup> not Sowerby, which Beushausen<sup>3</sup> refers to this genus, is rather similar in shape and markings, except that, according to the latter author, the ridges are numerous and crowded near the margins, and the shell shorter and the umbo higher.

The Carboniferous *Ct. Hallii*, Barrois,<sup>4</sup> agrees in shape, but differs in its less defined and regular ornament.

*Cucullæa antiqua*, Sowerby,<sup>5</sup> the type of which is in the Museum of the Geological Society, is almost exactly the same in shape, but it has a long stout clavicular ridge, is more convex, and is described as smooth. Sowerby does not appear to unite the two shells, which he places in different genera, though giving them the same specific name.

#### 4. CTENODONTA ? ELLIPTICA, *Phillips*, sp. Plate XIII, fig. 6.

1841. PULLASTRA ELLIPTICA, *Phillips*. Pal. Foss., p. 35, pl. xvii, fig. 54.

1893. CTENODONTA ELLIPTICA, *Collins*. Trans. Roy. Geol. Soc. Cornwall, vol. xi, p. 36.

*Description.*—Left valve of moderate size, flat, oblique, subcircular. Umbo somewhat anterior, flat, depressed, small and hardly defined. (Apex and hinge-line unseen.) Anterior margin broad, slightly convex. Inferior margin gently and regularly convex. Posterior margin convex below, straight and oblique above. Contour of back nearly flat, but sinking suddenly and rapidly close to the

<sup>1</sup> 1885, Hall, 'Pal. N. Y.,' vol. v., pt. i, No. 2, p. 343, pl. xlix, figs. 33—38.

<sup>2</sup> 1834—40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 279, pl. elix, fig. 10.

<sup>3</sup> 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 17, p. 83, pl. vi, fig. 16.

<sup>4</sup> 1882, Barrois, 'Mém. Soc. Géol. Nord,' vol. ii, No. 1, p. 339, pl. xvii, figs. 3—3 c.

<sup>5</sup> 1839, Sowerby, in Murchison's 'Sil. Syst.,' p. 602, pl. iii, figs. 1 b and 12 a.

margins, especially the inferior margin. Surface covered by about forty very distant, fine, sharp, elevated, erect, concentric threads, which occasionally become slightly irregular, are closer and smaller on the supero-lateral parts, and are crossed in the marginal regions by numerous microscopic radiating lineations, which, however, may possibly have been induced by other causes instead of being a true testaceous ornament.

*Size*.—About 24 mm. long, 22 mm. high, and 3 mm. deep.

*Locality*.—In the Barnstaple Athenæum is a fine but not very perfect example from Bradiford. Phillips describes his shell from South Petherwyn.

*Remarks*.—Our figured specimen exactly agrees with Phillips's figure, so that there can be no doubt of its identity. As its umbo and hinge are hidden, there is little direct evidence as to its genus. In general shape it closely mimics shells like *Astarte*, but its resemblance to adjacent species leaves little doubt that it belongs to the present genus.

Its transverse ornament is precisely similar to that of *Ct. antiqua*, Sowerby, sp., and it is quite within the range of possibility that further specimens might afford ground for regarding it as the aged form of a variety of that variable shell.

The present form has, however, such a distinctive, obliquely subquadrate shape, that, judging from what we know of it at present, there appears to be just grounds for believing Phillips to be right in regarding it as a distinct species.

*Affinities*.—*Paracyclas lirata*, Conrad, as given by Hall,<sup>1</sup> is identically ornamented, and approaches it in shape, but is more convex, and has much fewer ribs, and could claim kinship only on the assumption that the present species did *not* belong to the *Nuculidæ*.

##### 5. CTENODONTA ? TENSA, n. sp. Plate XII, figs. 8, 9 ? 9 a ?

? 1842. NUCULITES SULCATINA, Conrad. Journ. Acad. Nat. Sci. Philad., vol. viii, p. 250, pl. xv, fig. 10.

? 1881. LEDA PERDENTATA, Barrande. Syst. Sil. Bohém., vol. vi, pl. cclxx, fig. 2, 1-2.

? 1885. PALÆONEILO SULCATINA, Hall. Pal. N. Y., vol. v, pt. 1, No. 2, p. 347, pl. 1, figs. 42-46.

*Description*.—Shell of moderate size, convex, ovoid, very transverse, but narrower behind than in front. (Umbo unseen but apparently low, indistinct, and situated near the anterior end.) Hinge-line apparently very long, gently

<sup>1</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 441, pl. lxxii, figs. 2-19; and pl. xcv, fig. 19.

arched, bearing, at least on the posterior side, very numerous, small, short, parallel, oblique teeth. Posterior hinge-margin long, nearly straight, slightly oblique. Posterior margin narrow, and so deeply convex as to be nearly subangular. Inferior margin very long and gently convex. Contour of back moderately and evenly convex. Surface covered by numerous minute, irregular, parallel, sharpish, concentric striæ, one or two of which are definitely larger than the rest.

*Size*.—Height 10 mm., length 27 mm., depth of one valve about 3.5 mm.

*Locality*.—A fine specimen and its mould from Sloly are in the Barnstaple Athenæum. A cast from Barnstaple in the Museum of Practical Geology may belong to the same species.

*Remarks*.—As its interior is not certainly known its genus cannot be decided. The cast from Baggy differs so much that it is very doubtful if it is identical. The species appears to be well characterised, although there may be a little uncertainty about its exact shape, owing to the great amount of squeezing which the beds have evidently undergone. It occurs in the *Lingula squamiformis* beds.

*Affinities*.—*Leda perdentata*, Barrande, which belongs to the genus *Nuculites*, may possibly prove to be the same species.

The vaguely figured and described *Nucula latissima* of Phillips, seems broader behind, and is more likely to represent the shell described below than the present species.

From *Ctenodonta lirata* and *Ct. antiqua* it differs by its much greater length, and by its much finer and more irregular ornament, as it shows little or no signs of the lofty regular concentric bars which cover the surface of those shells.

*Cucullella tumida*, Sandb.,<sup>1</sup> which has somewhat the same dimensions, differs in being still longer and more trigonal.

*Nucula solenoides*, Goldfuss,<sup>2</sup> has a concave hinge-line, and *N. prisca*, Goldfuss,<sup>3</sup> appears to be more trigonal.

*Palæoneilo attenuata*, Hall,<sup>4</sup> has a median constriction on the back; and *P. sulcatina*, Hall, though closely resembling it, seems to have a loftier umbo and more lamellar ornament.

*Sanguinolaria elliptica*, F. A. Römer,<sup>5</sup> not Phillips,<sup>6</sup> approaches in shape, but

<sup>1</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 277, pl. xxix, figs. 6, 6 a.

<sup>2</sup> 1834-40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 151, pl. cxxiv, fig. 9.

<sup>3</sup> Ibid., p. 151, pl. cxxiv, fig. 7.

<sup>4</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 346, pl. 1, figs. 34-39.

<sup>5</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 26, pl. vi, fig. 27; and 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 1, p. 73, pl. iv, fig. 24.

<sup>6</sup> 1841, Phillips, 'Pal. Foss.,' p. 34, pl. xvii, fig. 53.



its surface is undescribed. It may be distinguished by having a loftier umbo and blunter anterior side, and perhaps by its hinge-line.

*Ct. hercynica*, Beus.,<sup>1</sup> is a similarly doubtful analogue.

*Sub-genus*—KOENENIA, Beushausen, 1884.

Beushausen separated this as a genus on account of its bent hinge-line and the absence of a marginal area to it, giving *Nucula Jasii*, Römer, as the type species'; but in his later work (1895) he sinks it as a group of *Ctenodonta*.

6. CTENODONTA (KOENENIA) cf. OBSOLETA, Goldfuss, sp. Plate XII, fig. 10.

*Description*.—Shell of moderate size, very transverse, very convex. Umbo large, flattened, incurved, and probably proximate, situated at or about the anterior third, and tending forward. Inferior margin long, nearly straight. Lateral margins apparently narrow and very deeply convex. Hinge-line gently arched, nearly as long as the shell, and very wide, imperfectly seen but bearing four or five very large, massive, vertical teeth at its extremities, and probably many others between them, which appear to become very minute near the umbo. Contour deeply and regularly convex, being steepest on the anterior side. Shell-structure very massive. Surface unknown. No clavicular process.

*Size*.—A defective valve measures about 17 mm. high, 30 mm. wide, and 7 mm. deep.

*Localities*.—Two casts from Braunton and one from Baggy Point are in the Museum of Practical Geology, and another from Frankmarsh is in my Collection.

*Remarks*.—These fragmentary casts show no signs of any clavicular process. They seem remarkable for the great size of the hinge and of the teeth; the latter having an appearance of being joined by slight transverse bars, which may, however, be due to accident. They certainly seem distinct from any accompanying species; but unfortunately the most characteristic specimens are too imperfect for figuring.

They bear resemblance to *Nucula obsoleta*, Goldfuss,<sup>2</sup> and to *Cucullæa Jasii*, F. A. Römer,<sup>3</sup> but in neither case is it easy to form an accurate idea of the exact shape of these German shells. Beushausen,<sup>4</sup> indeed, describes a shell more fully

<sup>1</sup> 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 1, p. 76, pl. iii, fig. 12.

<sup>2</sup> 1834-40, Goldfuss, 'Petref. Germ.,' vol. ii, p. 151, pl. cxxiv, fig. 6.

<sup>3</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 24, pl. vi, fig. 15.

<sup>4</sup> 1884, Beushausen, 'Abhandl. Geol. Specialk. Preuss.,' Band vi, pt. 1, p. 73, pl. iii, figs. 6, 7.

which he refers to Goldfuss's species, with some, as it seems to me, very reasonable doubt.<sup>1</sup>

### 3. Genus—NUCULITES, Conrad, 1841.

"Equivalve; hinge with cardinal teeth as in *Nucula*, but apparently uninterrupted beneath the apex; an interior rib, like that of *Solecurtus*, but narrower, extends from the apex either direct or slightly oblique towards the base, never passing much beyond the middle of the valve."

Conrad thus defines his genus, remarking that it has "much the exterior aspect of *Nucula*," but that the deep sinus in the cast gives the same distinction as between *Solen* and *Solecurtus*, and that it has no fossette in the hinge. *N. lamellosa*, Conrad, is the first of the nine species which he places under it. According to Fischer some of these species belong to *Nucula*, and some, with a clavicular ridge, to *Cleidophorus*, Hall, 1847. But Hall in 1883-5 appears to have sunk the latter genus, referring such ridged shells to *Nuculites*, and (*inter alia*) *Cleidophorus ovatus*, Sowerby, sp.

Conrad's generic definition seems perfectly clear and valid, whether or not he has been consistent in the species he has referred to it.

*Cucullella*, M'Coy, 1851, *Adranaria*, Munier-Chalmas, 1876, and *Cadomia*, de Tromelin, 1876, appear to be synonyms.

#### 1. NUCULITES? LATISSIMUS, Phillips, sp.? Plate XII, figs. 11, 11 a, 11 b.

1841. NUCULA LATISSIMA, Phillips. Pall. Foss., p. 137, pl. lviii, fig. 65\*.

? 1841. — OVATA, Phillips (pars, not Sowerby). Ibid., p. 39.

*Description*.—Shell rather small, oval, very convex and transverse. Umbo small, low, rounded, turning rather forward, situated at or about the anterior fifth of the length, and apparently bearing internally a median clavicular process which extends halfway down the back. Hinge-line very long, rather curved, with about four very minute, thin, radiating, central teeth under the umbo, nine large, oblique, strong anterior lateral teeth and about forty short, rather stout, perpendicular, parallel posterior lateral teeth. Anterior margin broad, and deeply and evenly convex. Inferior margin long and very slightly convex. Posterior margin much produced, and so deeply convex as to be almost bluntly angular. Contour of back very convex, sinking steeply in front. Surface ornamented by about thirty-

<sup>1</sup> 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 17, p. 74, pl. viii, figs. 8-10.

five very regular, minute, parallel, very distant, erect threads. Shell-structure apparently thick.

*Size*.—Height 12 mm., length 24 mm., depth of one valve 4 mm.

*Localities*.—Two specimens from Fremington are in the Barnstaple Athenæum; one defective specimen from Frankmarsh in my Collection; and one very obscure specimen from Barnstaple in the Woodwardian Museum.

*Remarks*.—Phillips's description of his *Nucula latissima* is only—"its great width is its chief characteristic." His figure is only the outline and hinge; his locality Pilton. All that can be said is that the present shell seems to agree exactly in shape, though Phillips's drawing perhaps implies rather fewer teeth. I have been unable to find his type specimen, and can therefore only refer our shell to his species doubtfully.

Again, Phillips identifies a shell from Meadfoot Sands with Sowerby's *Cucullæa ovata*,<sup>1</sup> and at the same time refers to a small doubtful specimen from Pilton. To whatever species the Meadfoot fossil may belong, the specimens before us appear distinctly to differ from Sowerby's shell by their much greater transverse-ness and less ovoid shape, though, as he has only figured a cast, the ornament cannot be compared. The doubtful specimen which he quotes from Pilton may possibly belong to the present species.

The existence of a clavicular process is not very certain, as the surface of the figured specimen is decayed about that part. Hence the genus must remain doubtful.

*Affinities*.—*Nucula Krotonis*, F. A. Römer,<sup>2</sup> which is the same as *Cucullella tenuiarata*, Sandberger,<sup>3</sup> is similar and possibly may prove identical. It seems, however, to differ in its more ovate shape. It appears, according to Beushausen, not to have a true clavicular ridge.

*Ct. lirata*, Phillips, sp., has a slighter hinge-line, fewer and stronger threads, no clavicular ridge, and a posterior constriction and emargination.

*Nucula tumida*, F. A. Römer,<sup>4</sup> and *N. polydonta*, F. A. Römer,<sup>5</sup> seem shorter and more oval, and the former at least has no clavicular ridge.

*Nuculites oblongatus*, Conrad,<sup>6</sup> sp., which Hall<sup>7</sup> compares with *Nucula* (*Nuculites*) *ovata*, Phillips, appears to differ in having longer, closer teeth, forming an unbroken sweep and not extending so far in front.

<sup>1</sup> 1839, Sowerby, in 'Murchison Sil. Syst.,' p. 602, pl. iii, fig. 12 *b*.

<sup>2</sup> 1850, F. A. Römer, 'Beitr. Harzgeb.,' pt. i, p. 13, pl. iii, fig. 5, and 1895, Beushausen, 'Abhandl. k. Preuss. Geol. Landes.,' n. s., pt. 17, p. 72, pl. v., figs. 24 *a*, *b*, 25.

<sup>3</sup> 1853, Sandberger, 'Verst. Rhein. Nassau,' p. 276, pl. xxix, figs. 4, 4 *a*.

<sup>4</sup> 1843, F. A. Römer, 'Verst. Harzgeb.,' p. 24, pl. xii, fig. 30.

<sup>5</sup> 1855, F. A. Römer, 'Beitr. Harzgeb.,' pt. 3, p. 12, pl. iii, fig. 8.

<sup>6</sup> 1841, Conrad, 'Geol. Surv. N. Y., Ann. Rept.,' p. 50, plate, fig. 8.

<sup>7</sup> 1885, Hall, 'Pal. N. Y.,' vol. v, pt. 1, No. 2, p. 324, pl. xlvii, figs. 1—12.



V. *Family*—ARCIDÆ, Gray, 1840.1. *Genus*—CUCULLÆA, Lamarck, 1801.

The arrangements of the teeth show that the first and therefore probably both of the following species do not belong to *Dolabra*, M'Coy. There seems no reason for removing them from the genus in which they were placed by Sowerby and by Phillips.

1. CUCULLÆA UNILATERALIS, Sowerby. Plate XI, figs. 4—13, and Plate XIII, figs. 10, 10 *a*, 11.

1840. CUCULLÆA UNILATERALIS, Sowerby. Geol. Trans., ser. 2, vol. v, pt. 3, pl. liii, fig. 23.
1840. — TRAPEZIUM, Sowerby. Ibid., pl. liii, fig. 24.
1840. — ANGUSTA, Sowerby. Ibid., pl. liii, fig. 25.
1840. — HARDINGII, Sowerby. Ibid., pl. liii, figs. 26, 27.
1841. — AMYGDALINA, Phillips. Pal. Foss., p. 40, pl. xviii, figs. 66 *a—d*.
1841. — HARDINGII, Phillips. Ibid., p. 40, pl. xviii, figs. 67 *a, b*; and pl. xix, figs. 67 *a, b*.
1841. — ANGUSTA, Phillips. Ibid., p. 41, pl. xix, figs. 68 *a—c*.
1841. — UNILATERALIS, Phillips. Ibid., p. 41, pl. xix, figs. 69 *a—c*.
1841. — TRAPEZIUM, Phillips. Ibid., p. 41, pl. xix, fig. 70.
1855. DOLABRA ANGUSTA, M'Coy. Brit. Pal. Foss., p. 393.
1855. — HARDINGI, M'Coy. Ibid., p. 395.
1855. — UNILATERALIS, M'Coy. Ibid., p. 395.
1895. — — var. CONDUSORUM, Beushausen. Abh. k. Preuss. Geol. Landes., n. s., pt. 17, p. 34, pl. viii, figs. 25—28.
1895. — cf. ANGUSTA, Beushausen. Ibid., p. 35, pl. viii, fig. 29.

*Description*.—Shell large, convex, very variable in shape. Umbo large, more or less anteriorly situated, elevated above the hinge-margin, incurved, tending obliquely forward, and more or less truncated behind. Hinge-area large, flat, triangular, transversely striated. Hinge-line straight, large, shorter than the length of the shell, bearing a few subparallel, long, transverse teeth both before and behind. Anterior margin roundly convex, narrower than the posterior margin. Inferior margin slightly convex, usually oblique. Postero-inferior corner produced, rounded. Posterior margin oblique, straight or rather convex. Contour of back very convex, greatest depth on line from umbo to postero-

inferior corner. Surface covered with numerous sharpish, rather irregular transverse lines and undulations of growth.

*Size*.—Specimens measure 55 mm. long by 55 mm. high by 35 mm. deep; or 40 mm. long by 35 high by 20 deep.

*Localities*.—Numerous specimens are in the Woodwardian (including Sowerby's types) and the British Museums, the Barnstaple Athenæum, the Museum of Practical Geology (including the seven specimens figured by Phillips<sup>1</sup>), and Mr. Hamling's and my own collections from Sloly, Marwood, Shirwell, Baggy Point and Knowle Quarry near Braunton, North Moulton (one), and Tiverton (four).

*Remarks*.—Sowerby and Phillips have divided the *Cucullææ*, which are so common in, and so characteristic of, a zone in the Marwood beds, into five or six species; but it may be observed that at least Professor Phillips had great doubts as to the correctness of so doing.

Of *C. angusta*, *C. unilateralis*, and *C. trapezium* he writes, "The three last species are so very closely allied, that on looking over many specimens we find it doubtful whether the differences observed are other than those of degree. The same thing is observable at Marwood in regard to *Avicula damnoniensis*, which varies so much in its proportions as to require the pointing out of three distinct forms."

McCoy, uniting *C. amygdalina* to *C. unilateralis*, and *C. trapezium* to *C. Hardingii*, reduced Phillips's five species to three. But *C. amygdalina* is intermediate between *C. angusta* and *C. unilateralis*, and *C. Hardingii* bears much the same relation to *C. angusta* which *C. amygdalina* bears to *C. trapezium*. It may be said indeed, on the other hand, that these five forms, though bearing evident relationship, are easily distinguishable, and can be definitely defined, and that it is possible to class specimens under them. But, even so, it soon appears, when any large number of specimens are under examination, (1) that hardly any two that may be placed under any of these forms are exactly alike, showing that each group is merely a collection of very variable shapes bearing some resemblance in general features; and (2) that many specimens may with equal justice be classed under more than one of the five forms: that is to say, that they not only vary within themselves, but run in all directions into each other. It seems, therefore, necessary to believe that we have really only a single very variable species, and that the five forms are not even local varieties, but simply accidental variations of shape. It must further be remembered that these fossils have been subjected to a good deal of squeezing and pressure, and that consequently some amount of the variability of the specimens may be due to that, and therefore have no real zoological existence at all. Lastly it may be remarked that the five forms described by no means exhaust the shapes which the species assumes; and that the only consistent course is either to

<sup>1</sup> 1841, Phillips, 'Pal. Foss.,' pp. 40, 41, pls. xviii and xix, figs. 66—70.

describe a number of new forms in addition to those already described, or to unite all in one single species.

I should perhaps hardly have ventured upon the latter course had not my own view been confirmed by the remarks of Mr. Townshend Hall, who has collected at different times vast numbers of these fossils, and who remarked to me, when first I saw his collection, that he thought they ought all to be united, and that he had arranged several hundred specimens in one continuous chain. He has since favoured me with the following note, which he made in 1877. "Between *C. amygdalina* on the one hand, and *C. angusta* on the other, there are various intermediate forms, to which the names *C. Hardingii*, *unilateralis*, and *depressa* have been given. Is *C. Hardingii* a good species? *C. unilateralis* is the mean between *C. amygdalina* and *C. trapezium*."

On examining the specimens at Barnstaple with me, Dr. Hicks expressed himself as inclined to the same view.

For the sake of definition it may perhaps be convenient to retain the five names, *amygdalina*, *Hardingii*, *unilateralis*, *trapezium*, and *angusta* for the classification of shapes, provided it be understood that no zoological import be attached to them.

In figuring the species I have attempted chiefly to show forms intermediate between these named varieties.

It may be observed that young shells are often flatter, and have smaller and less prominent umbones.

## 2. CUCULLÆA DEPRESSA, *Phillips*. Plate XI, fig. 14 and Plate XII, figs. 2, 3, 3 a.

1841. CUCULLÆA DEPRESSA, *Phillips*. Pal. Foss., p. 42, pl. xix, figs. 71 a—c.

1841. — COMPLANATA, *Phillips*. Ibid., p. 214.

1855. DOLABRA DEPRESSA, *M'Coy*. Brit. Pal. Foss., p. 394.

*Description*.—Shell large, convex, slightly inequivalve and inequilateral, variable in shape, trigonal. Hinge-margin short, straight, about one-third of the length. Umbones prominent, incurved, rather distant, inclined somewhat forward, and situated subcentrally. Cardinal area apparently rather broad and concave. Anterior margin broad, prominent, and roundly convex. Inferior margin oblique, nearly straight. Postero-inferior corner steeply rounded. Posterior margin oblique, nearly straight, meeting the hinge-margin at a low obtuse angle. Contour deeply convex on the line of greatest depth from umbo to the postero-inferior corner; before which it slopes flatly out to the margins, becoming slightly concave near the anterior end of hinge-line; and behind which it is almost perpendicular, becoming concave to form a small angular posterior wing. Surface smooth?



Anterior muscle-scar small, circular, situated marginally immediately under the anterior end of hinge-margin.

*Size*.—Height 58 mm., length 73 mm., depth 40 mm.

*Localities*.—There are three specimens from Marwood in the Museum of Practical Geology, two of which were figured by Phillips; and several from Marwood in the Woodwardian Museum.

*Remarks*.—This species is remarkable for its short hinge, and its peculiar trigonal, wedge-like form. The few specimens known are very various in shape, but appear to be probably different from the common and equally variable *Cucullæa* by which they are accompanied. Phillips observes, "The extreme depression of this shell (compared with the former) is remarkable, and does not depend on distortion or pressure, but it is very uncertain how much must be allowed to accidental or local variations of form."

## 2. *Genus*—PARALLELODON, *Meek and Worthen*, 1866.

### 1. PARALLELODON PYGMEUS, *Whiteaves*, var. INFANS, var. nov. Plate XII, figs. 4, 5.

1892. MACRODON PYGMEUS, *Whiteavess*. Cont. Canad Pal., vol. i, pt. 4, p. 299, pl. xxxix, figs. 2, 3.

*Description*.—Cast minute, convex, semi-oval, transverse, and very oblique. Umbo small, acute, oblique, tending forward, distant, elevated a little above the hinge, and situated between the anterior one-third and one-fourth of the length. Hinge apparently broad and massive, equal (or very nearly so) to the greatest length, bearing two very long and strong obliquely transverse teeth. Anterior margin very narrow, obliquely convex. Inferior margin very long, obliquely straight in front, roundly convex behind. Posterior margin almost vertical, broadly convex. Contour of cast concave on hind wing, roundly convex on the line of greatest depth from umbo to postero-inferior corner, depressed behind the line from umbo to antero-inferior corner, and very deep in front. Shell-structure very massive.

*Size*.—A specimen measures 2.5 mm. high by 3.5 mm. long.

*Localities*.—In the Barnstaple Atheneum is a specimen on the same slab as *Crenipecten auritus* from Bradiford, and in the Porter Collection are two specimens on a slab from Poleshill.

*Remarks*.—Only the cast of this minute shell is known. It appears evidently to belong to the genus *Parallelodon*.



## PLATE I.

### *Fish Remains.* (Page 3.)

FIG.

1. Slab containing several detached fragments of scales,  $\times 3$ . 1 *a*, portion of a scale,  $\times 15$ , showing structure. Strand, Ashford. Barnstaple Athenæum.

### CARIDERPESTES GYIUS, n. sp. (Page 3.)

2. Specimen showing numerous segments, every fourth of which bears an elongated lance-like appendage,  $\times 2$ . The body appears gradually to narrow till it expands at the extremity, where there are obscure signs of a pair of stout jointed appendages. Sloly? Barnstaple Athenæum.

### ECHINOCARIS WHIDBORNEI, Jones and Woodward. (Page 6.)

3. Type specimen figured by Jones and Woodward,  $\times 3$ . Sloly. Woodwardian Museum.

### ANATIFOPSIS? ANGLICA, n. sp. (Page 9.)

4. A fragmental specimen, showing a narrow proximal rim and an angulated superior margin. Sloly. Porter Collection.

### CERATIOCARIS? SUBQUADRATA, n. sp. (Page 7.)

5. A slab containing two specimens, showing the general shape, the inferior rim, and the oblique ornament,  $\times \frac{3}{2}$ . 5 *a*, contour of anterior end which is hidden under the matrix. East Anstey. My Collection.

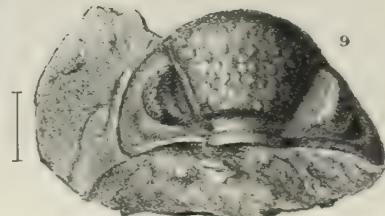
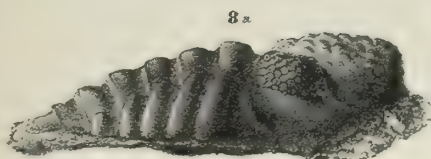
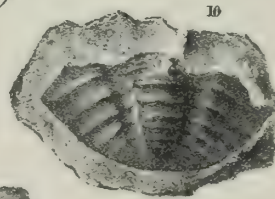
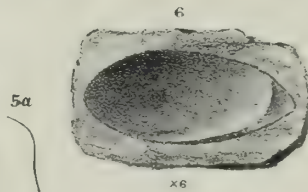
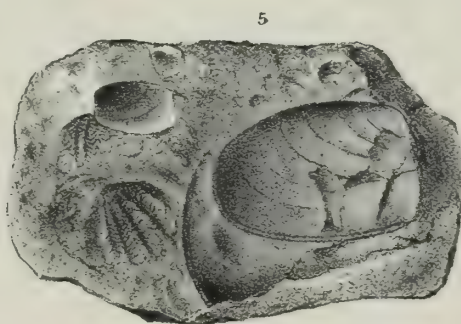
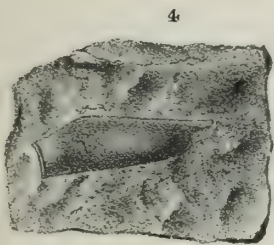
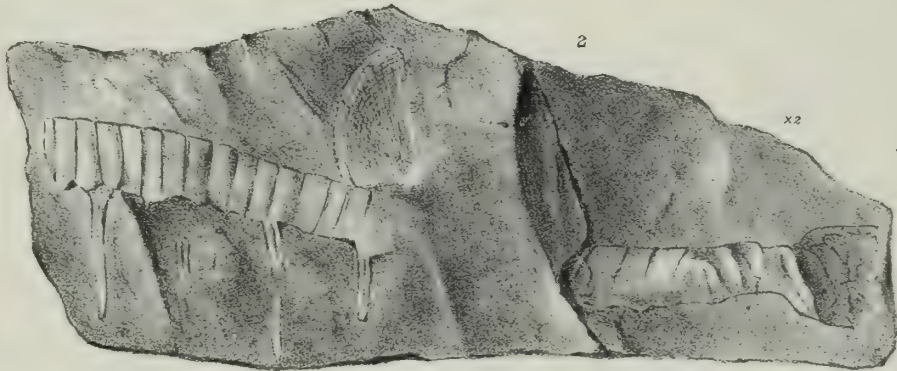
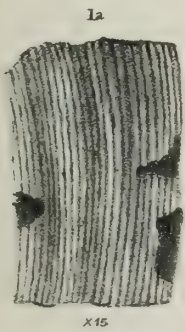
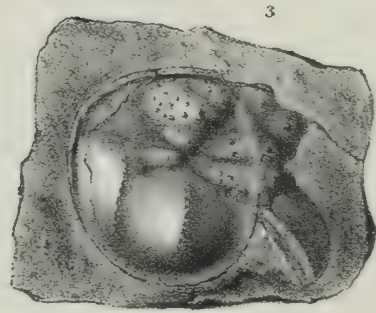
### CERATIOCARIS? sp. (Page 8.)

6. An indistinct specimen,  $\times 6$ . S.W. of Sloly. Woodwardian Museum.

### PHACOPS LATIFRONS, Bronn, sp. (Page 10.)

7. Pygidium, showing tuberculated segments, especially on the axis,  $\times 3$ . Barnstaple. Woodwardian Museum.
8. Large, but laterally squeezed, specimen. 8 *a*, side view. Barnstaple. Woodwardian Museum.
9. A small but well-preserved head,  $\times 2$ . 9 *a*, side view. Top Orchard. Porter Collection.
10. Pygidium,  $\times \frac{3}{2}$ . 10 *a*, side view. Barnstaple. Museum of Practical Geology.











## PLATE II.

### PHACOPS LATIFRONS, *Bronn*, sp. (Page 10.)

#### FIG.

1. Body and tail of a very short specimen, the shape of which is perhaps due to pressure,  $\times 2$ . 1 *a*, side view. Barnstaple. Woodwardian Museum.
2. A large and undistorted specimen of the eleven segments of the body. 2 *a*, side view. Top Orchard. Barnstaple Athenæum.
3. A similar but obliquely compressed specimen, perhaps regarded by Salter as *Ph. lævis*,  $\times 1\frac{1}{2}$ . Brushford. Museum of Practical Geology.
4. A small pygidium, similar to that indistinctly seen in fig. 1,  $\times \frac{3}{2}$ . Barnstaple. Museum of Practical Geology.

### PHILLIPSIA HICKSII, n. sp. (Page 11.)

5. A perfect but very much decayed specimen, which shows (in the specimen) the position of the eye, the cheek-spine, and the characters of the tail and nine segments in the body,  $\times 3$ . Shore near Fremington. Barnstaple Athenæum.
6. A very perfect though slightly distorted pygidium, taken from a wax impression of the mould, showing the ornament, the rings of the axis (except the terminal ones, which are blurred), the divided segments of the limbs, and the defined rim,  $\times 3$ . Pilton. Barnstaple Athenæum.
7. Another similar specimen, which has been elongated by pressure, and shows well the numerous rings of the axis,  $\times 3$ . Braunton Road. Barnstaple Athenæum (and cast, Porter Collection).
8. A glabella, which has been elongated by pressure, but shows the ornament, the margins of the facial suture, and the lobes,  $\times 6$ . Pottington. Porter Collection.

### BRACHYMETOPUS WOODWARDII, n. sp. (Page 14.)

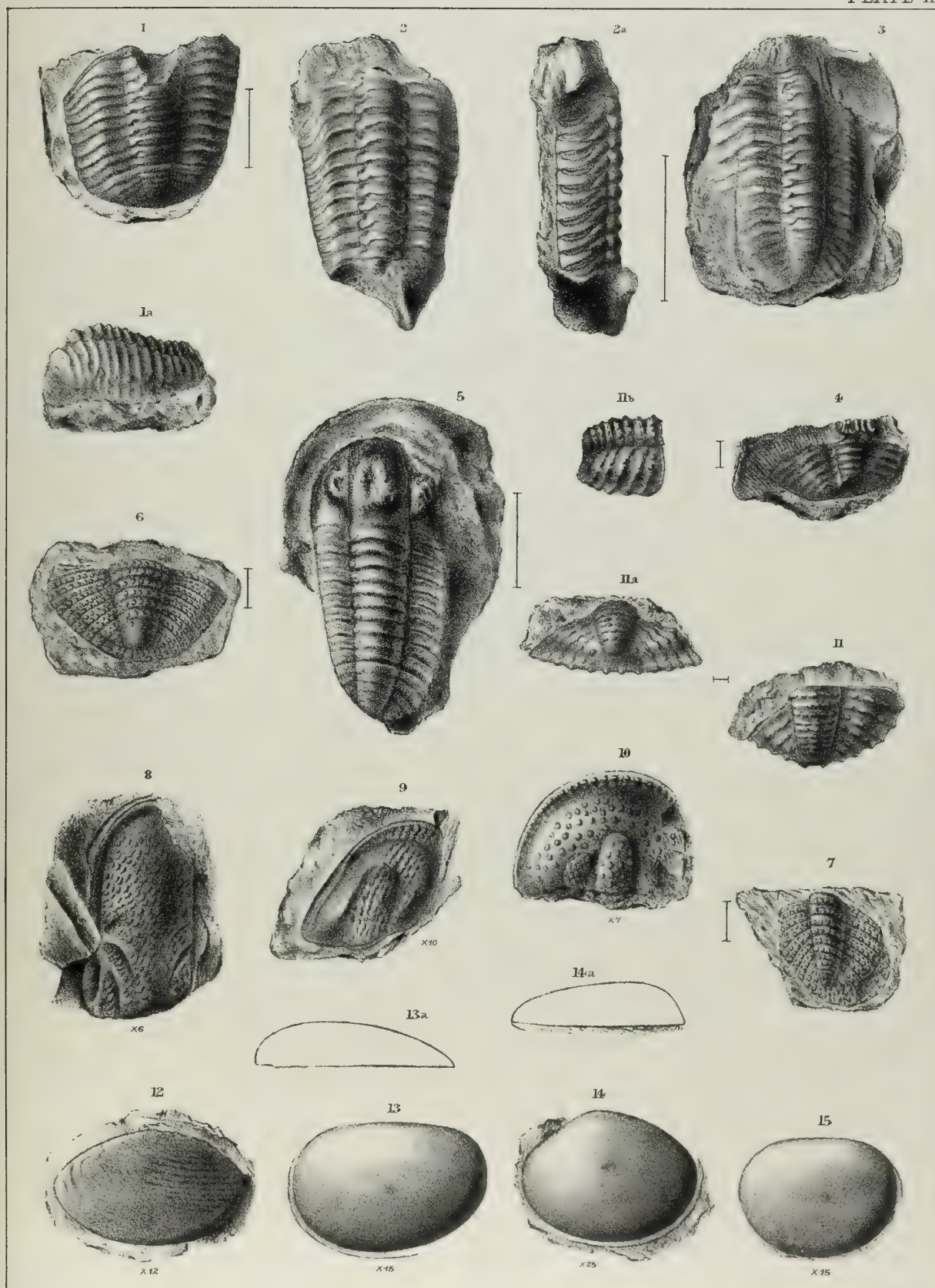
9. A very small and much distorted head,  $\times 10$ . Pottington. Porter Collection.
10. Another more perfect specimen, showing the glabella and one of the eyes,  $\times 7$ . Lane between Wrafton and Heanton. My Collection.
11. A pygidium probably belonging to the same species,  $\times 7$ . 11 *a*, side view. 11 *b*, rear view. Pilton. Porter Collection.

### CERATIOCARIS ? sp. (Page 8.)

12. A flat specimen, showing the rim,  $\times 12$ . Croyde. Hamling Collection.

### ISOCHILINA CANALICULATA, *Krause*. (Page 15.)

13. Right valve, partially showing the rim,  $\times 15$ . 13 *a*, dorsal view. Pilton. Porter Collection.
14. Small distorted valve, showing the rim,  $\times 25$ . 14 *a*, ventral view. Saunton Hotel. My Collection.
15. Valve of a very short specimen,  $\times 15$ . Pilton. Porter Collection.









## PLATE III.

*All the figures in this Plate are from specimens in my Collection, except where otherwise stated.*

FIG.

ISOCHILINA CANALICULATA, *Krause*. (Page 15.)

1. Right (?) valve,  $\times 15$ . 1*a*, ventral view. 1*b*, end view. Upcott Arch Quarry.
2. Left valve,  $\times 15$ . 2*a*, ventral view. 2*b*, end view. Upcott Arch Quarry.

APARCHITES LINDSTRÖMI, *Jones*, var. EXCELLENS, n. v. (Page 16.)

3. Left valve,  $\times 15$ . 3*a*, ventral view. Kingdon's, Shirwell. Barnstaple Athenæum.

PRIMITIA SPARSINODOSA, n. sp. (Page 16.)

4. Small left valve,  $\times 30$ . Saunton Hotel. Partridge Collection.
5. Large right valve,  $\times 30$ , having small tubercles, which are not, however, distinctly shown in the figure. Saunton Hotel. Partridge Collection.
6. Ventral view of another right valve,  $\times 30$ , showing one of the tubercles. Saunton Hotel. Partridge Collection.

PRIMITIA, sp. (Page 17.)

7. Specimen,  $\times 30$ , showing the indistinct furrow and roughened surface. Pilton. Porter Collection.
- 8, 9. Specimens,  $\times 30$ , showing the dorsal furrows more clearly, and a rim at the posterior end. Saunton Hotel. Partridge Collection.
- 10, 11. Very much distorted valves, doubtfully referred to this species,  $\times 25$ . Saunton Hotel.

PRIMITIA ? sp. (Page 18.)

12. Left valve,  $\times 30$ , showing the slight furrow. Saunton Hotel. Partridge Collection.

PRIMITIA DORSICOENIS, *Ulrich*, sp. (Page 18.)

13. Right valve,  $\times 30$ , showing the small dorsal projection. Saunton Hotel. Partridge Collection.

PRIMITIA VESTITA, n. sp. (Page 19.)

14. Specimen,  $\times 15$ . Pilton. Porter Collection.

BEYRICHTIA ÆQUILATERA, *Hall?* (Page 20.)

15. Specimen,  $\times 30$ , showing furrows, but perhaps shortened by pressure. Saunton Hotel.

BEYRICHTIA DAMESII, *Krause?* (Page 21.)

16. Left valve,  $\times 30$ , showing the lobes. Pilton. Porter Collection.

BEYRICHTIOPSIS RUPERTI, n. sp. (Page 22.)

17. Right valve,  $\times 30$ , showing the tubercles, the longitudinal ridges, and the fringed border. Pilton. Porter Collection.

KLÖDENIA BURSEIFORMIS, n. sp. (Page 22.)

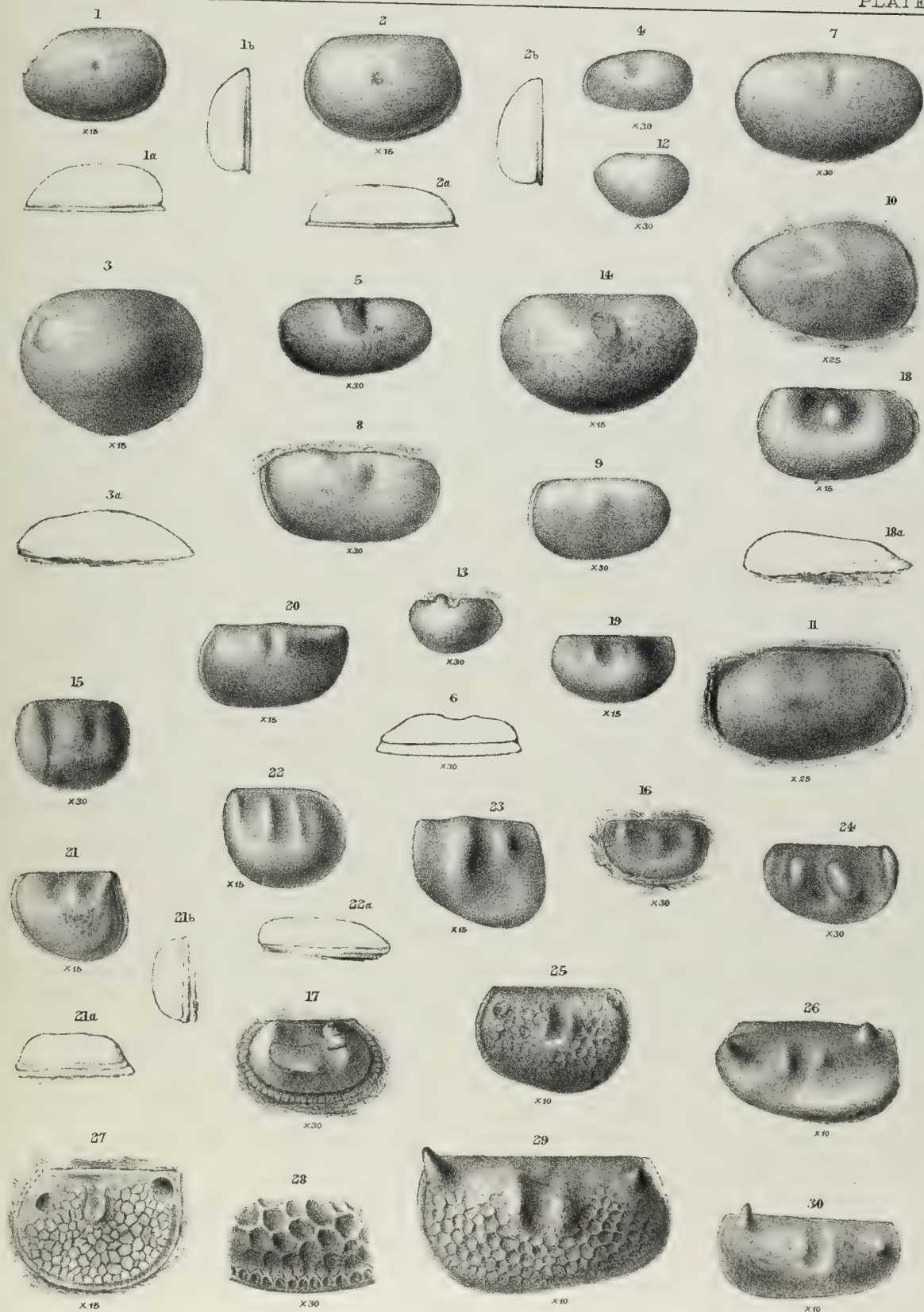
18. Right valve,  $\times 15$ , showing the median defined lobe and the confluent lateral lobes, probably lengthened by pressure. 18*a*, ventral view. Laticosta Cave, Baggy.
- 19, 20. Two valves,  $\times 15$ , lengthened by pressure, indistinctly showing the lobes. Same locality.
21. Left valve,  $\times 15$ , shortened by pressure, with rim and small lobes. 21*a*, ventral view. 21*b*, end view. Same locality.
22. Right valve,  $\times 15$ , shortened by pressure, in which the lobes appear long and narrow, and the front lobe apparently bifid. 22*a*, ventral view. Same locality.
23. Left valve,  $\times 15$ , obliquely distorted, in which the posterior lobe seems small and oval and the ventral side low and flattened. Same locality.

ULRICHTIA INTERSERTA, n. sp. (Page 23.)

24. Left valve,  $\times 30$ , showing the thickened elevated ends and the two defined central lobes. Laticosta Cave, Baggy.

PRIMITIA BOVIFRONS, n. sp. (Page 19.)

25. Left valve,  $\times 10$ , showing the surface, the central margined furrow, and the position of the horns; perhaps slightly shortened by pressure. Laticosta Cave, Baggy.
26. Cast of left valve,  $\times 10$ , showing the horns, slightly distorted. Same locality.
27. Mould of a small right valve,  $\times 15$ , showing the ornament and the border; squeezed into a symmetrical shape. Same locality.
28. Portion of another specimen,  $\times 30$ , showing the character of the ornament and the crenulated border. Same locality.
29. Very large right valve,  $\times 10$ , drawn from an external mould. (The posterior horn is restored.) Pilton. Porter Collection.
30. Cast of a right valve,  $\times 10$ , much elongated by pressure, showing the horns. Laticosta Cave, Baggy.









## PLATE IV.

### GONIATITES, sp. (Page 25.)

FIG.

1. Specimen, showing the inflexion of the whorls about the umbilicus,  $\times 2$ . 1 *a*, another view. Barnstaple. Woodwardian Museum.

### AGONIATITES, sp. (Page 24.)

2. Specimen, much obscured by matrix, but retaining signs of septa and of tubercles round the umbilicus. Kingdon's, Shirwell. Barnstaple Athenæum.

### POTERICERAS? sp. (Page 27.)

3. Specimen, much obscured by matrix, but giving the general shape. 3 *a*, another view, showing the position of the siphuncle. Kingdon's, Shirwell. Barnstaple Athenæum.

### ORTHOCERAS SPECIOSUM, *Münster*. (Page 29.)

4. Specimen, showing the septa. 4 *a*, transverse section. Kingdon's, Shirwell. Barnstaple Athenæum.

### POTERICERAS? sp. (Page 28.)

5. Specimen, figured by Phillips as *Orthoceras imbricatum*, Hisinger. Marwood. Museum of Practical Geology.

### ORTHOCERAS, sp. (Page 32.)

6. Natural section of a specimen showing the septa, the siphuncle, and the vasiform envelope of the siphuncle,  $\times 2$ . Kingdon's, Shirwell. Barnstaple Athenæum.

### ORTHOCERAS BARUMENSE, n. sp. (Page 30.)

7. Small fragmentary specimen, showing the ornament, but not very clear signs of the annuli,  $\times 5$ . 7 *a*, lower view. Ironpost, near Dulverton. My Collection.
8. Larger specimen, showing the annuli and the rate of tapering,  $\times 1$ . 8 *a*, section of lower end. 8 *b*, a portion of its mould,  $\times 10$ . Frankmarsh. My Collection.

### ACTINOCERAS? (HURONIA) CRICKII, n. sp. (Page 33.)

9. Specimen, probably belonging to this species, wanting the surface, but showing the septa and a longitudinal carina, and with signs of longitudinal striæ. Baggy. Museum of Practical Geology.
10. Natural section, much decayed, showing the siphuncular arrangement. Locality? Barnstaple Athenæum.
11. Another specimen, of which the exterior parts are lost, but in which the siphuncular arrangements are preserved in good condition,  $\times \frac{3}{2}$ . Barnstaple. Woodwardian Museum.
12. Another specimen, showing the siphuncular arrangements and retaining the septa. 12 *a*, portion,  $\times 2$ . 12 *b*, side view. "Marwood Beds." British Museum.

### CONULARIA DEFLEXICOSTA, *Sandberger*? (Page 35.)

13. A fragmentary specimen, seen from within,  $\times 2$ . Pilton. Porter Collection.

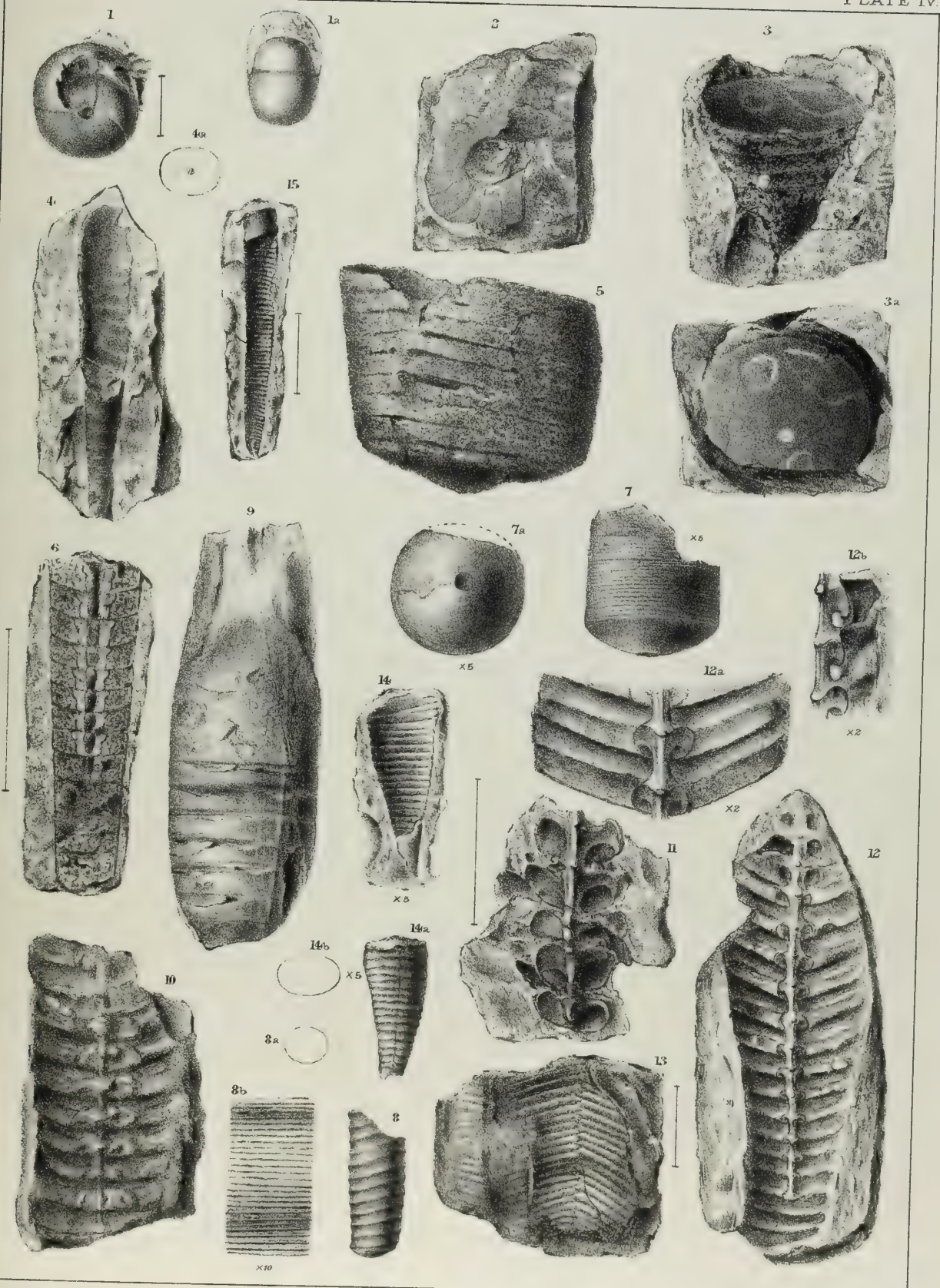
### TENTACULITES CONICUS, *F. A. Römer*. (Page 36.)

14. Mould of a specimen,  $\times 5$ . 14 *a*, cast. 14 *b*, transverse section. Top Orchard. Barnstaple Athenæum.

### TENTACULITES (COLEOLUS?) TENTACULARIS, *Phillips*, sp. (Page 38.)

15. A somewhat worn specimen,  $\times 3$ . Pilton. Porter Collection.





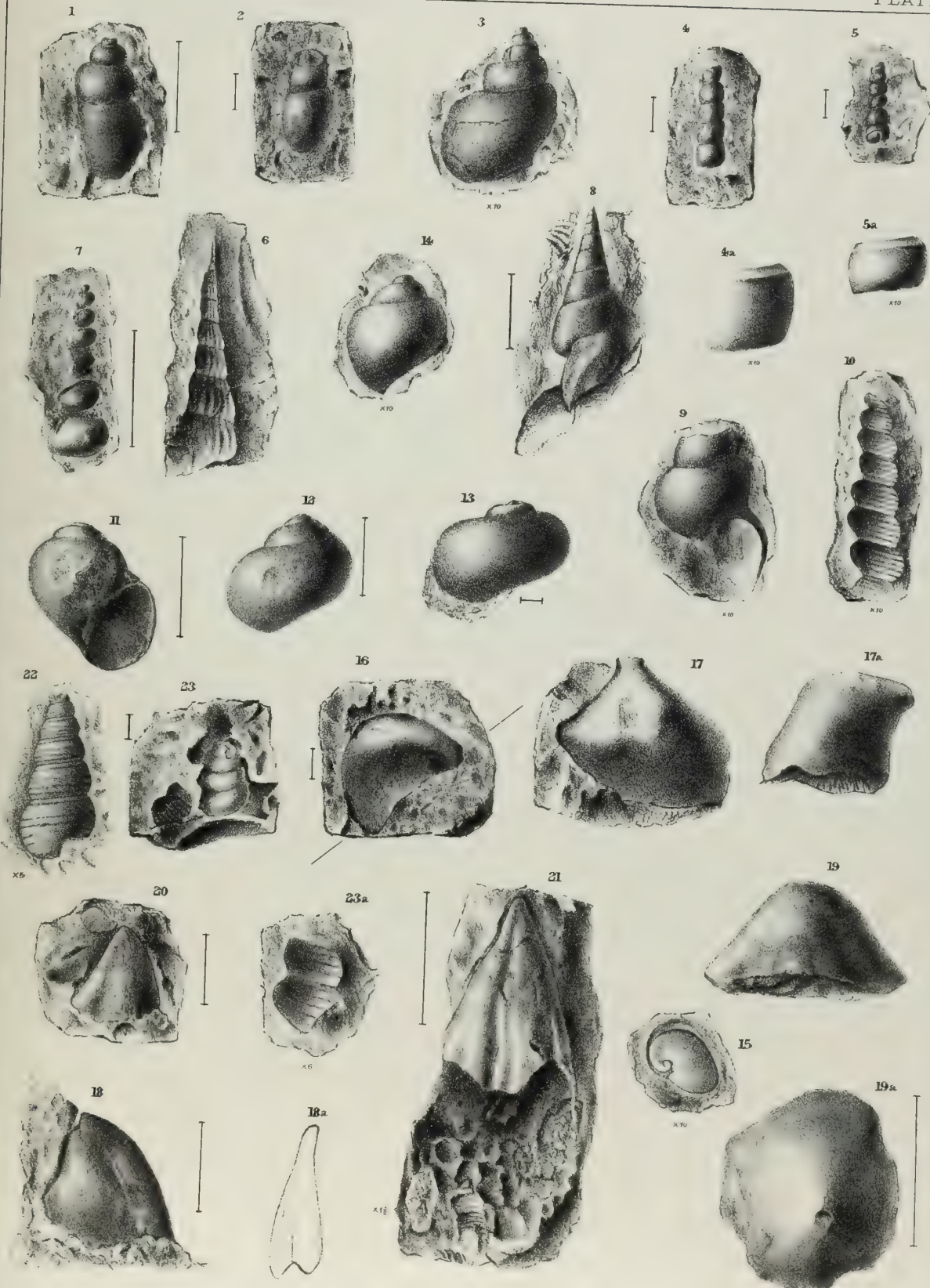






## PLATE V.

- FIG.                      *MACROCHILINA TURBINEA*, n. sp. (Page 39.)
1. Specimen, obscured by matrix,  $\times \frac{3}{2}$ . Kingdon's, Shirwell. Barnstaple Athenæum.
  2. A crushed and rather doubtful specimen,  $\times 3$ . Vicarage Well, Pilton. Barnstaple Athenæum.
- MACROCHILINA PUSILLA*, n. sp. (Page 40.)
3. Specimen, wanting the surface, slightly obscured by matrix,  $\times 10$ . Pilton. Porter Collection.
- LOXONEMA TROCHLEATUM*, Münster, sp. (Page 41.)
4. Specimen, retaining the surface on lowest whorl,  $\times 3$ . 4a, lowest whorl,  $\times 10$ . Kingdon's, Shirwell. Barnstaple Athenæum.
  5. Another similar specimen,  $\times 3$ . 5a, lowest whorl but one,  $\times 10$ . Kingdon's, Shirwell. Barnstaple Athenæum.
- LOXONEMA ANGLICUM*, d'Orbigny. (Page 43.)
6. Mould of a specimen, showing the ornament. Brauntun. Museum of Practical Geology.
- HOLOPELLA TENUISULCATA*, Sandberger. (Page 51.)
7. Cast of a specimen, much embedded by matrix,  $\times \frac{3}{2}$ . Kingdon's, Shirwell. Barnstaple Athenæum.
- LOXONEMA HALLII*, n. sp. (Page 41.)
8. Specimen, drawn from a defective mould and cast,  $\times 3$ . Vicarage Well, Pilton. Barnstaple Athenæum.
- PLEUROTOMARIA*, sp. (Page 59.)
9. Cast of a defective specimen, which retains some signs of ornament, though hidden in the drawing,  $\times 10$ . Pilton. Porter Collection.
- ACLISINA LONGISSIMA*, n. sp. (Page 52.)
10. Mould of a portion of a small shell, retaining eight whorls, showing the ornament and the narrowness of the whorls,  $\times 10$ . Pilton. Porter Collection.
- NATICOPSIS HALLII*, n. sp. (Page 44.)
11. Cast of an elongate specimen, showing the inner lip and the columella,  $\times \frac{3}{2}$ . Marwood Beds. Museum of Practical Geology.
  12. Cast of a shorter specimen,  $\times \frac{3}{2}$ . Marwood Beds. Museum of Practical Geology.
  13. Cast of a very small and short specimen, probably the young form of this species,  $\times 6$ . Baggy Point. Hamling Collection.
- NATICA ? MERIDIONALIS*, Phillips. (Page 45.)
14. Cast of a small and doubtful specimen,  $\times 10$ . Ironpost. My Collection.
- CAPULUS ROSTRATUS*, Trenkner ? (Page 46.)
15. Apical view of a small and very doubtful specimen (now mislaid).
  16. Basal view of a small specimen,  $\times 3$ . Pilton. Porter Collection.
- CAPULUS TERMINALIS*, Whidborne. (Page 46.)
17. Lateral view of the cast of a large specimen, slightly distorted at the apex. 17a, lower view Pilton. Porter Collection.
- CAPULUS COMPRESSUS*, Goldfuss, sp. (Page 47.)
18. Upper view of the cast of a compressed specimen,  $\times \frac{3}{2}$ . 18a, lateral view. Top Orchard Quarry. Barnstaple Athenæum.
- ORTHONYCHIA ROTUNDA*, n. sp. (Page 48.)
19. Upper view of a specimen, slightly enlarged. 19a, apical view, showing the shape of the oral margin. Pilton. Porter Collection.
- ORTHONYCHIA ACUTA*, F. A. Römer, sp. (Page 48.)
20. Upper view of a compressed specimen,  $\times \frac{3}{2}$ . Sowden, near Barnstaple. Barnstaple Athenæum.
  21. Another specimen, which is attached to the tegmen of *Actinocrinus Porteri*, n. sp.,  $\times \frac{3}{2}$ . Pilton. Porter Collection.
- MURCHISONIA SIMILIS*, Trenkner. (Page 61.)
22. Specimen possessing transverse striæ reflexed in the sinus-band, which are not, however, shown in the drawing, which is reversed from the mould,  $\times 5$ . Vicarage Well, Pilton. Barnstaple Athenæum.
  23. Mould and cast (?) of a fragmentary specimen,  $\times 3$ . 23a, mould enlarged, showing the four spiral threads. Vicarage Well, Pilton. Barnstaple Athenæum.









## PLATE VI.

### ORTHONYCHIA ACUTA, *F. A. Römer*, sp. (Page 48.)

FIG.

1. Lateral view of a very elongate specimen, defective near the apex,  $\times \frac{3}{2}$ . 1 *a*, apical view, showing the size and shape of the oral margin. Top Orchard Quarry. Woodwardian Museum.
2. Lateral view of a shorter specimen, which has been somewhat compressed in fossilisation. 2 *a*, apical view. Marwood Parish. Porter Collection.

### HOLOPELLA TENUISULCATA, *Sandberger*. (Page 51.)

3. Cast of a small specimen, retaining a small portion of its surface,  $\times 3$ . 3 *a*, surface,  $\times 10$ . Kingdon's, Shirwell. Barnstaple Athenæum.

### EUOMPHALUS VERMIS, n. sp. (Page 52.)

4. Lateral view of a very small specimen,  $\times 10$ . 4 *a*, apical view. Pilton. Porter Collection.

### RHAPHISTOMA JUNIUS, *de Koninck*. (Page 54.)

5. Lateral view of a specimen, retaining part of the surface,  $\times 3$ . 5 *a*, apical view. 5 *b*, upper surface of a portion of a whorl,  $\times 10$ , showing the ornament. Pilton. Porter Collection.
6. Lateral view of another specimen,  $\times 5$ . West of Saunton Court. Woodwardian Museum.
7. Lateral view of a rather lofty variety,  $\times 5$ . 7 *a*, apical view showing the ornament, which is continued further from the suture than usual. West of Saunton Court. Woodwardian Museum.

### PLEUROTOMARIA, sp. (Page 59.)

8. A doubtful and imperfect specimen, partly retaining the ornament, but obscured in shape by lying aslant on the slab,  $\times 10$ . Pilton. Porter Collection.

### PLEUROTOMARIA HAMLINGII, n. sp. (Page 56.)

9. A well-preserved specimen, showing its shape and the sinus-band at the shoulder of the whorls,  $\times 3$ . 9 *a*, portion of whorl,  $\times 10$ . Kingdon's, Shirwell. Barnstaple Athenæum.

### PLEUROTOMARIA ASPERA, *Sowerby*. (Page 57.)

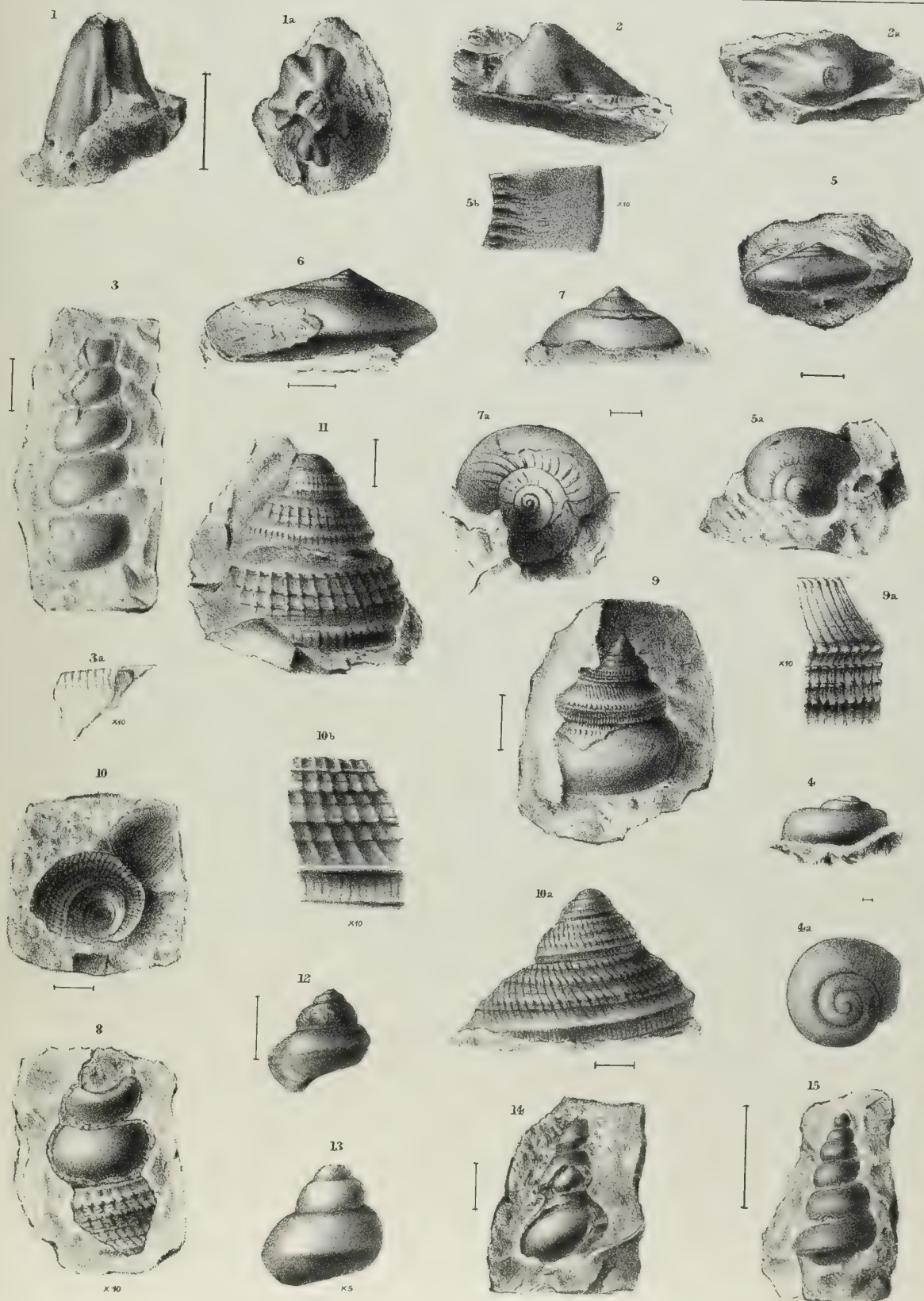
10. Specimen of a mould, showing an unusually fine ornament,  $\times 3$ . 10 *a*, wax cast taken from the same specimen,  $\times 6$ ; the elevated sinus-band is not clearly shown. 10 *b*, portion of whorl,  $\times 10$ . "Marwood beds, east of Barnstaple." Museum of Practical Geology.
11. Another specimen, of rather elongate form and with coarser ornament, showing the convexity of the sinus-band,  $\times 4$ . Petherwyn. Museum of Practical Geology.
12. Cast of a specimen, which may be the original of Phillips's fig. 177\*. Petherwyn. Museum of Practical Geology.
13. Cast of a small specimen very doubtfully referred to this species,  $\times 5$ . Poleshill. Porter Collection.

### MURCHISONIA ANGLICA, *d'Orbigny*. (Page 59.)

14. A small specimen, showing sinus-band, and apparently identical with the species figured by Phillips from Barnstaple,  $\times 3$ . Pilton. Porter Collection.

### MURCHISONIA, sp. (Page 60.)

15. Specimen of a cast, but showing sinus-band, and very similar to an ordinary form of *M. turbinata*, Schlotheim,  $\times \frac{4}{3}$ . Baggy Point. Museum of Practical Geology.









## PLATE VII.

### BELLEROPHON (BUCANIA) ELEGANS, *d'Orbigny*. (Page 62.)

1. Small specimen, imperfectly showing surface,  $\times 6$ . 1 *a*, portion of surface,  $\times 25$ , showing spiral and very fine transverse lines. Pilton. Porter Collection.

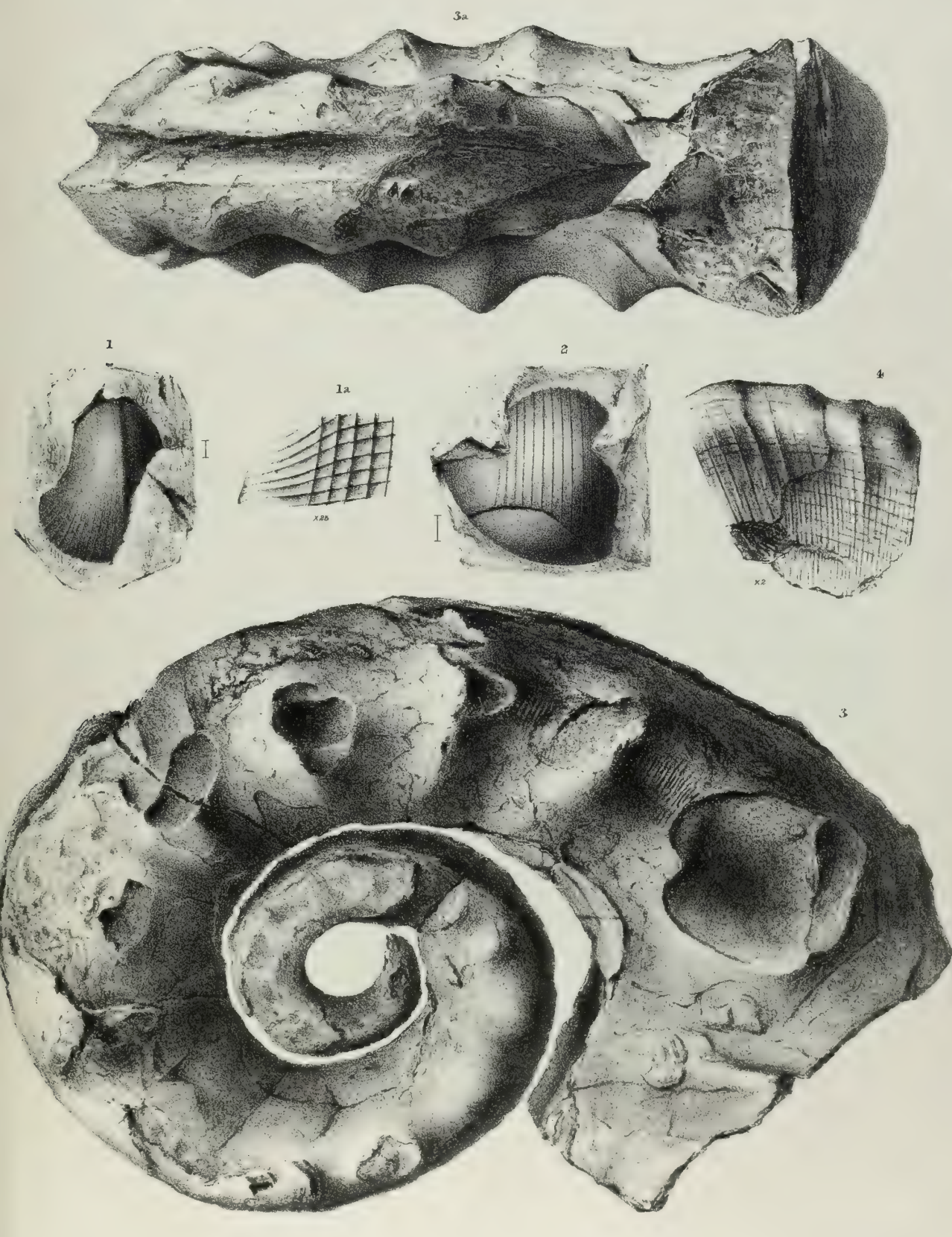
### EUPHEMUS BARUMENSIS, n. sp. (Page 70.)

2. Specimen figured by Phillips as *Bellerophon Urvii*, Fleming,  $\times 6$ . Baggy Point. Museum of Practical Geology.

### SUBCLYMENIA SYMONDSII, MS. (Page 26.)

3. Very large specimen, almost entirely a cast, but occasionally showing signs of surface-ornament. [The suture-lines, not having been observed until this drawing had been completed, are not represented in it.] Luscott, near Braunton. Museum of Practical Geology.
4. Wax cast from a smaller fragmental specimen of the mould, showing the external ornament,  $\times 2$ . Luscott? Museum of Practical Geology.











## PLATE VIII.

### BELLEROPHON LABYRINTHODES, n. sp. (Page 63.)

FIG.

1. Specimen, retaining the surface,  $\times 3$ . 1 *a*, portion of surface  $\times 8$ . Kingdon's, Shirwell. Barnstaple Athenæum.
2. Specimen with still finer ornament,  $\times 6$ . 2 *a*, upper view showing the zigzag course of the superficial ornament, and the traces of transverse lines beneath it. 2 *b*, portion of surface,  $\times 15$ . Baggy Point. Museum of Practical Geology.

### BELLEROPHON SUBGLOBATUS, M'Coy. (Page 64.)

3. Specimen of a cast which has more obliquely flattened sides than usual,  $\times 2.5$ . 3 *a*, upper view, showing umbilicus. Marwood Beds. Museum of Practical Geology.

### SALPINGOSTOMA? MACROMPHALUS, F. A. Römer, sp. (Page 66.)

4. Specimen of a cast defective about the mouth, showing the rising of the sinus-band,  $\times \frac{4}{3}$ . 4 *a*, upper view, showing the large umbilicus and elliptic coiling. Kingdon's, Shirwell. Barnstaple Athenæum.
5. Another specimen, much obscured by matrix, but showing some part of the oral expansion. 5 *a*, another view, showing the contour of the whorl near the mouth. Kingdon's, Shirwell. Barnstaple Athenæum.

### TROPIDODISCUS TRILOBATUS, Sowerby, sp. ? var. BISULCATUS, F. A. Römer. (Page 68.)

6. Specimen, showing the concavity of the sides, and the extremely wide umbilicus,  $\times 3$ . 6 *a*, lateral view. Baggy Point. Museum of Practical Geology.

### BELLEROPHON, sp. (Page 65.)

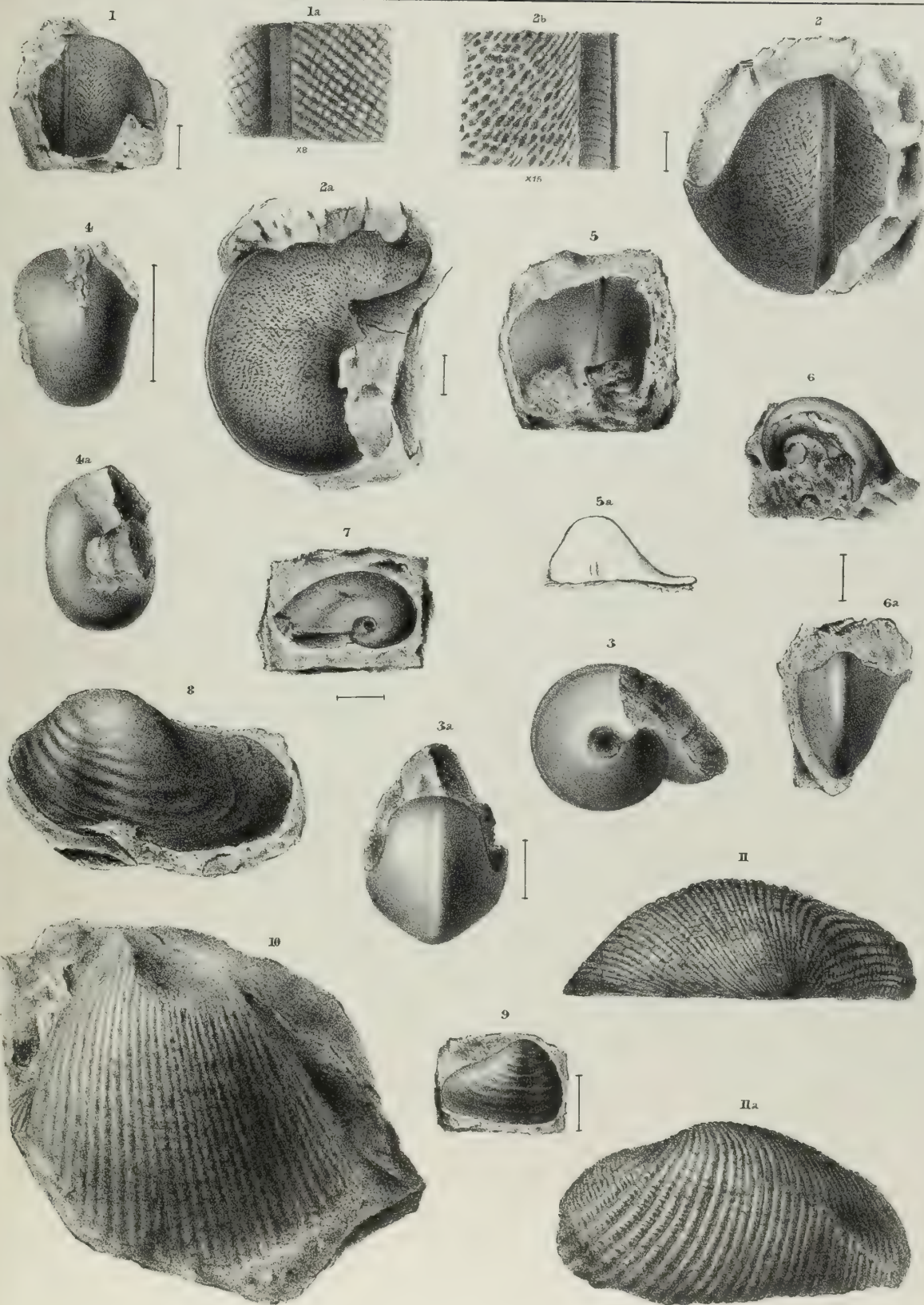
7. Lower view of a specimen in poor preservation,  $\times 3$ . Vicarage Well, Pilton, Barnstaple Athenæum.

### LEPTODOMUS CONSTRICTA, M'Coy (Page 75.)

8. A large specimen, slightly invaded by matrix below. Marwood. Museum of Practical Geology.
9. Small specimen, lying rather obliquely in the matrix, which slightly overlaps its anterior and inferior margins, and presenting a great likeness to Phillips's figure of his *Cypricardia impressa*, Sow. Roborough. Porter Collection.

### PANENKA ANGLICA (Page 72.)

10. A large specimen, apparently somewhat shortened by pressure, in which the median ribs are narrower than those on each side. Top Orchard. Barnstaple Athenæum.
11. Another specimen, longitudinally compressed, showing the recurved umbo and the narrowness of the median ribs. 11 *a*, upper view. Barnstaple. Woodwardian Museum.









## PLATE IX.

FIG.

### SPATHELLA MUNDA, n. sp. (Page 115.)

1. Specimen, wanting the surface, but showing the ornamentation and the shape of the shell,  $\times \frac{3}{2}$ .  
1 a. Anterior view. Fremington. Porter Collection.

### SANGUINOLITES PORTERI, n. sp. (Page 77.)

2. Specimen, showing the shape and ornament,  $\times \frac{3}{2}$ . 2 a. Anterior view. Pilton. Porter Collection.

### EDMONDIA ? ATHENÆ, n. sp. (Page 81.)

3. Specimen, defective in front,  $\times 3$ . Bradiford. Barnstaple Athenæum.

### SANGUINOLITES MIMUS, n. sp. (Page 78.)

4. Specimen, slightly defective in the supero-anterior part. "Marwood Beds." Museum of Practical Geology.
6. Specimen, vertically compressed. Pilton. Porter Collection.
7. Specimen of a cast,  $\times 2$ . Poleshill. Porter Collection.

### EDMONDIA BODANA, F. A. Römer, sp. (Page 80.)

5. Doubtful specimen, defective above,  $\times \frac{3}{2}$ . Roborough. Porter Collection.
8. Specimen, retaining the surface,  $\times 2$ . Kingdon's, Shirwell. Barnstaple Athenæum.

### SPHENOTUS HICKSII, n. sp. (Page 83.)

9. Specimen, defective above, but showing the angular keel and the depressed back,  $\times \frac{3}{2}$ . Ilfracombe Road, near Barnstaple. Museum of Practical Geology.

### SPHENOTUS SOLENOIDES, Hall ? (Page 83.)

10. Specimen, retaining the surface, but possibly laterally distorted,  $\times 2$ . South-west of Sloly. Woodwardian Museum.
11. Very imperfect and distorted specimen. South-west of Sloly. Woodwardian Museum.

### PROTHYRIS RECTA, n. sp. (Page 86.)

12. Right valve, showing the surface-ornament, but slightly overlapped by matrix in front. South Cave, Baggy. Museum of Practical Geology.
- 13, 14. Casts of two valves, showing the anterior notch and the internal ridges. South Cave, Baggy. Museum of Practical Geology.

### PROTHYRIS CONTOERTA, n. sp. (Page 87.)

15. Cast of right valve, showing the anterior notch and the internal radiating ridges,  $\times 2$ . Kingdon's, Shirwell. Barnstaple Athenæum.
16. Similar cast, very defective above, but possessing the anterior notch and three transverse teeth,  $\times 2$ . 16 a. Portion of surface, more enlarged, showing the very fine threads. Kingdon's, Shirwell. Barnstaple Athenæum.

### PROTHYRIS SCALPRATA, n. sp. (Page 88.)

17. Specimen of both valves in contact, showing the shape and the anterior notch,  $\times 2$ . Plaistow Mill Quarry (Sloly Beds). Museum of Practical Geology.
18. Another specimen, defective at the umbo, but showing the ornament and the anterior notch,  $\times 2$ . South-west of Sloly. Woodwardian Museum.

### PHTHONIA, sp. (Page 85.)

19. Specimen of the posterior part of a shell  $\times \frac{4}{3}$ . Top Orchard. Barnstaple Museum (and mould, Porter Collection).

### CYPRICARDINIA SCALARIS, Phillips, sp. (Page 90.)

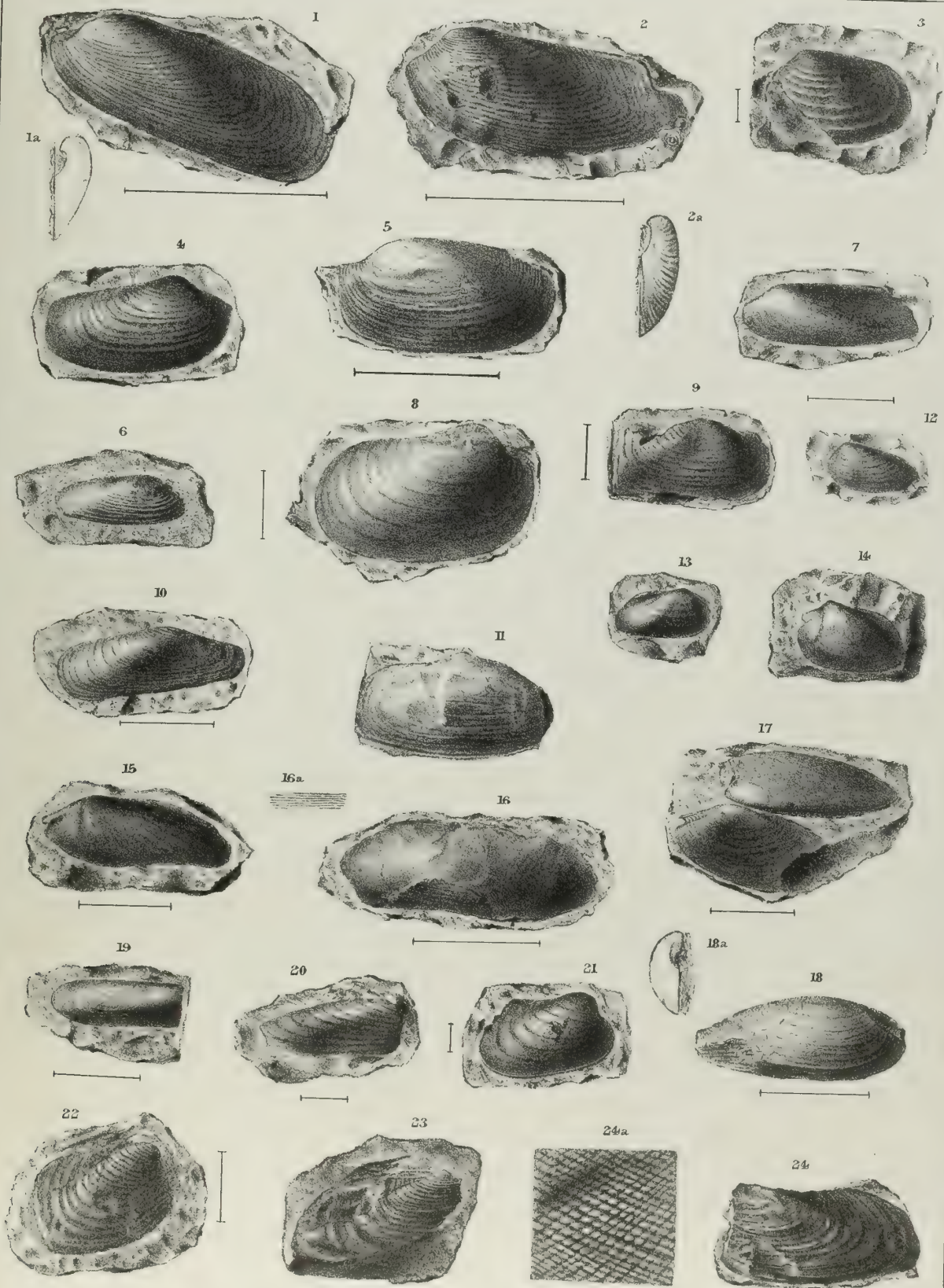
20. Elongate specimen, distorted by pressure,  $\times 3$ . Pilton. Porter Collection.
21. Shorter specimen, showing hind wing,  $\times 3$ . Poleshill. Porter Collection.

### CYPRICARDINIA ?, sp. (Page 91.)

22. Specimen, much obscured by matrix,  $\times \frac{3}{2}$ . Sloly. Barnstaple Athenæum.

### LEPTODOMUS SEMISULCATA, Sowerby, sp. (Page 76.)

- 23, 24. Imperfect specimens. 24 a. Portion of surface, showing part of one of the transverse ridges,  $\times 15$ . South-west of Sloly. Woodwardian Museum.









## PLATE X.

### SCALDIA? LONGA, n. sp. (Page 89.)

FIG.

1. Small specimen, retaining surface, with a nearly central umbo,  $\times 2$ . 1 *a*. Lateral view. Baggy Point, South Cave. Museum of Practical Geology.
2. Similar specimen of a left valve,  $\times 2$ . Baggy Point, South Cave. Museum of Practical Geology.

### MYOPHORIA INFLATA, F. A. Römer, sp. (Page 92.)

3. Cast of left valve, showing the hinge and the anterior muscle-scar. 3 *a*. Hinge-line,  $\times \frac{3}{2}$ . Coomhola Grits, County Cork. Museum of Practical Geology.
4. Specimen of a similar right valve. 4 *a*. Section. Coomhola Grits, County Cork. Museum of Practical Geology.

### MYOPHORIA DELTOIDEA, Phillips, sp. (Page 93.)

5. Cast, with a very small umbo. 5 *a*. Hinge-line,  $\times \frac{3}{2}$ . 5 *b*. Anterior view. Marwood. Museum of Practical Geology.
6. Cast, showing the posterior muscle-scar,  $\times \frac{3}{2}$ . 6 *a*. Anterior view. Marwood. Porter Collection.
7. Specimen, which is possibly the type of Phillips's species. 7 *a*. Posterior view. Petherwyn. Museum of Practical Geology.
8. Hinge-line of another specimen, showing the posterior muscle-scar,  $\times 4$ . Marwood. Museum of Practical Geology.

### MYOPHORIA TRIGONA, F. A. Römer, sp. (Page 96.)

9. Large specimen, showing the hinge and the general outline, though probably rather distorted. Richards's Summer House, Croyde Bay. Museum of Practical Geology.
10. Large cast, much distorted by oblique compression, showing the hinge, the pallial line, and the posterior spoon-like process. 10 *a*. Hinge,  $\times 2$ , showing the teeth. Barnstaple. Museum of Practical Geology.
11. Cast of the closed valves, preserving the natural shape, showing the position of the muscle-scars, the pallial line, and the spoon-like process,  $\times 2$ . 11 *a*. Upper view, showing the umbones and the interlocking of the teeth. Barnstaple. Woodwardian Museum.
12. Cast of a right valve, showing the anterior muscle-scar and the marginal concavity, which indicates the thickness of the shell,  $\times \frac{3}{2}$ . Pilton. Porter Collection.

### NUCULA LINEATA, Phillips. (Page 97.)

13. Cast of the closed valves, showing the umbo and the sudden termination of the hinge,  $\times 3$ . 13 *a*. Lateral view. Upcott. Barnstaple Athenæum.
14. Small fragmentary specimen, retaining surface, and showing the ornament,  $\times 5$ . West of Saunton Court. Woodwardian Museum.

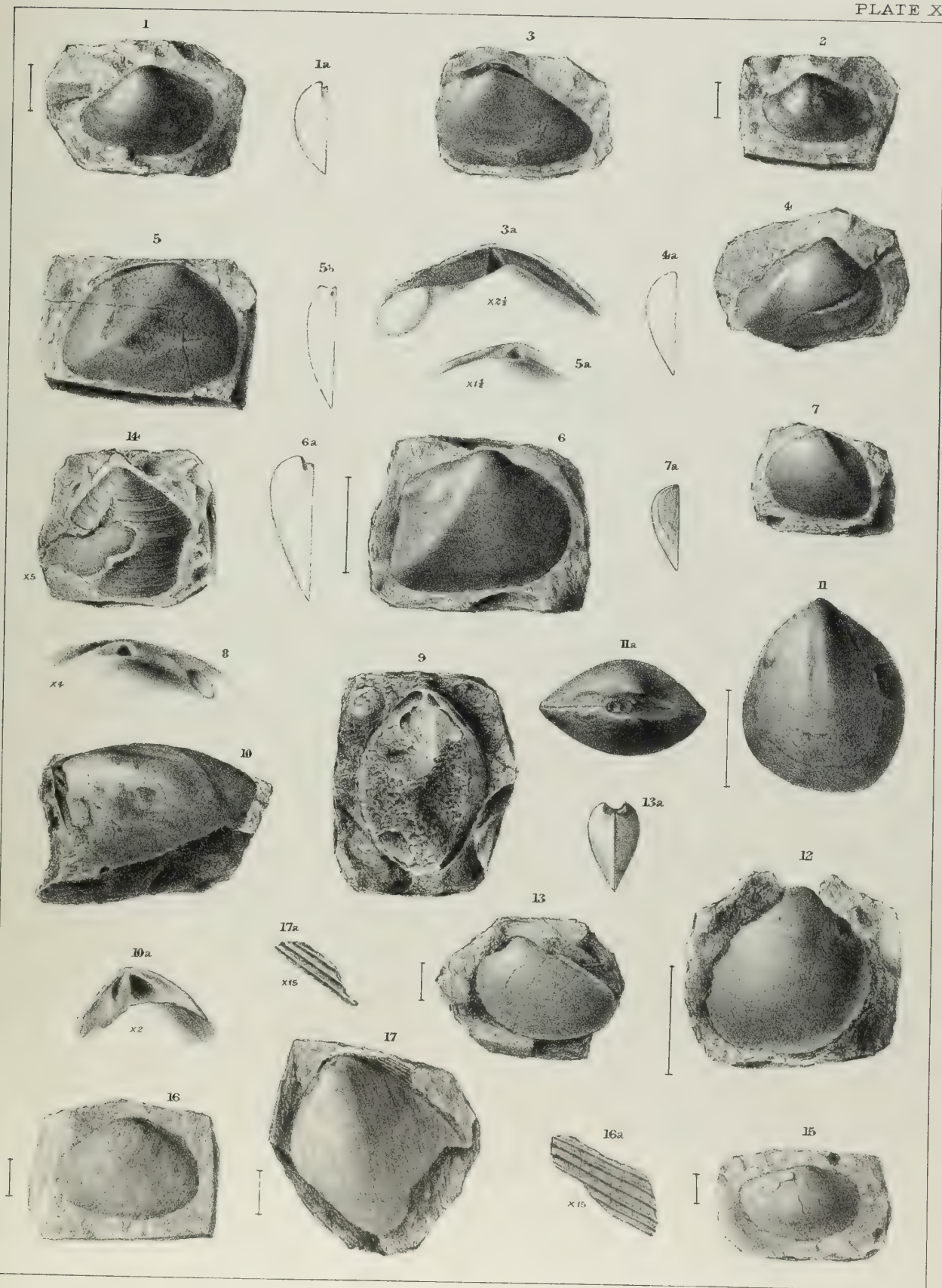
### CTENODONTA NEWTONII, n. sp. (Page 99.)

15. Specimen, showing the general form,  $\times 3$ . Fremington. Barnstaple Athenæum.

### PROTHYRIS SCALPRATA? n. sp. (Page 88.)

16. Specimen, so greatly distorted that the umbo assumes a central position,  $\times 3$ . 16 *a*. Portion of surface, showing the lineations behind the umbo,  $\times 15$ . Sloly. Barnstaple Athenæum.
17. Another extremely distorted specimen,  $\times 4$ . 17 *a*. Portion of lineated surface behind the umbo,  $\times 15$ . South-west of Sloly. Woodwardian Museum.











## PLATE XI.

### SPATHELLA MUNDA, n. sp. (Page 115.)

FIG.

- 1, 2. Casts of the right and left valves, showing the punctated umbo and the anterior muscle-scar,  $\times 2$ . Frankmarsh. My Collection.

### EDMONDIA ? HAMLINGII, n. sp. (Page 82.)

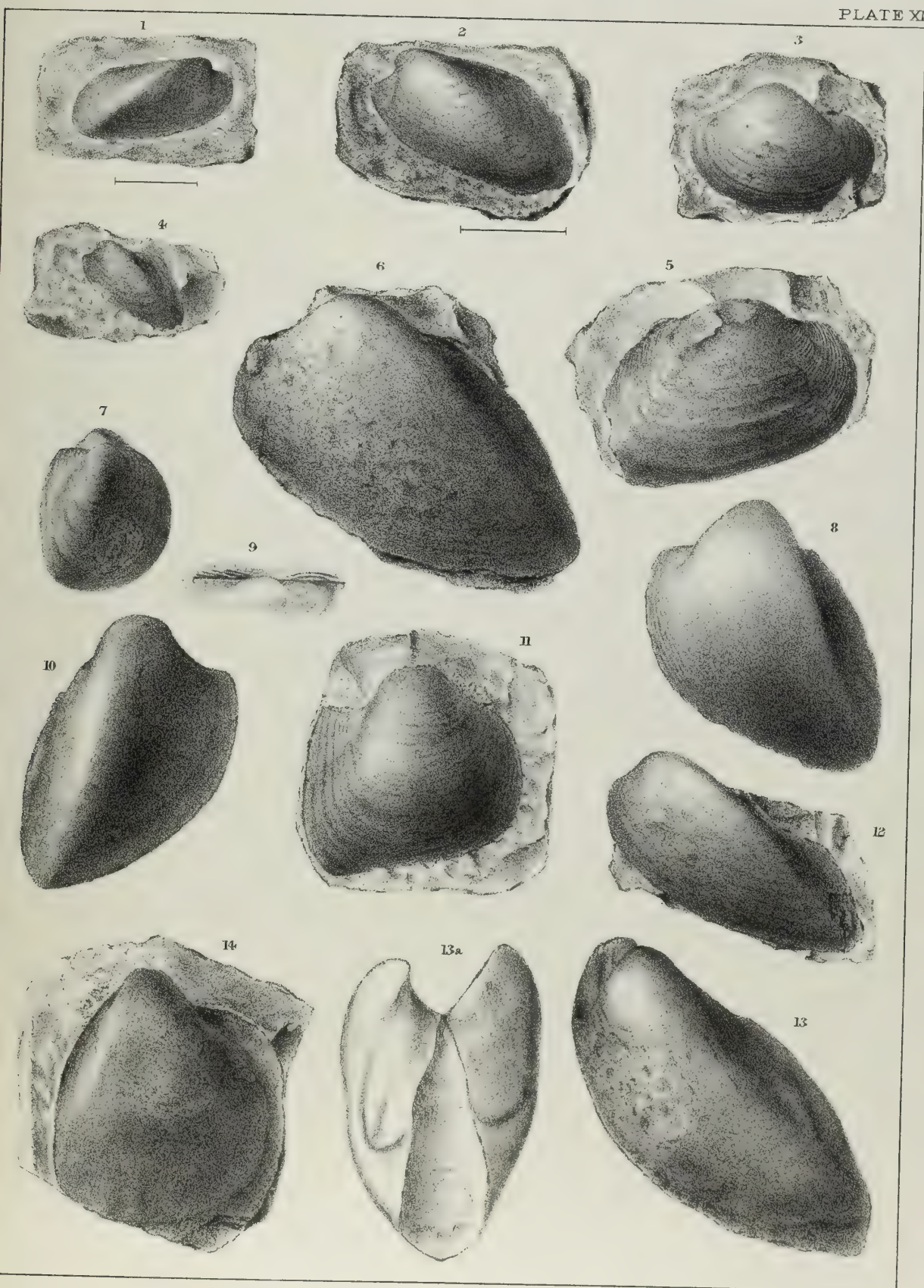
3. Specimen, showing the surface and the position of the umbo. Rolled block from Saunton Point. Hamling Collection.

### CUCULLÆA UNILATERALIS, Sowerby (Page 109.)

4. A young shell, between varieties *unilateralis* and *amygdalina*. Marwood. Woodwardian Museum.
5. Flat specimen of the variety *Hardingii*. Sloly. Barnstaple Athenæum.
6. Rather flat specimen, between varieties *unilateralis* and *amygdalina*. Braunton. Hamling Collection.
7. Small, deep, and very inequivalved specimen, between the varieties *angusta* and *unilateralis*. Marwood. Woodwardian Museum.
8. Very deep specimen with very large umbo, exceeding the variety *unilateralis*. Marwood. Woodwardian Museum.
9. The hinge of a specimen of var. *amygdalina*, drawn obliquely to show the teeth which are nearly transverse, but slope slightly upwards from each side of the umbo. Baggy Point. Barnstaple Athenæum.
10. Specimen, beyond variety *unilateralis* in obliquity and the large size of the umbo. Braunton. Hamling Collection.
11. Specimen, between varieties *angusta* and *trapezium*, and differing from them in the large size of its umbo. Sloly. Barnstaple Athenæum.
12. Specimen, beyond variety *amygdalina* in depth and transverseness. Marwood. Woodwardian Museum.
13. Cast of extreme variety beyond *trapezium* in obliquity, with very elongate and distant umbones, showing anterior muscle-scars. Barnstaple. Woodwardian Museum.

### CUCULLÆA DEPRESSA, Phillips. (Page 111.)

14. Specimen showing the pallial line, the impression of the hinge, and two or three faint rays near the inferior margin. Marwood. Woodwardian Museum.









## PLATE XII.

### SPHENOTUS? SOLENIFORMIS, *Goldfuss*, sp. (Page 84.)

FIG.

1. Specimen, much worn, but showing the anterior muscle-scar, and the flattened posterior slope.  
1 *a*. Upper view, showing the umbones and the posterior gape. Locality? Mantell Collection, British Museum.

### CUCULLÆA DEPRESSA, *Phillips*. (Page 111.)

2. Very large and long specimen, slightly displaced or squeezed, so that the umbo of the right valve has come into view behind the other. Marwood. Museum of Practical Geology.
3. Phillips's type, which is shorter and much more curtailed behind. 3 *a*. Upper view. Marwood. Museum of Practical Geology.

### PARALLELODON PYGMEUS, *Whiteaves*, var. *INFANS*, n. v. (Page 112.)

- 4, 5. Two minute casts, which seem to vary in length, one of which shows the posterior teeth,  $\times 10$ . Poleshill. Porter Collection.

### PARALLELODON PRISCUS, *Goldfuss*, sp. (Page 113.)

6. Cast of a left valve,  $\times \frac{3}{2}$ . Ironpost. My Collection.

### MODIOLOPSIS, sp. (Page 114.)

7. Left valve, much obscured by matrix,  $\times 2$ . South Cave, Baggy Point. Museum of Practical Geology.

### CTENODONTA? TENSA, n. sp. (Page 104.)

8. Specimen showing the ornament, the subangular posterior side, and signs of the lateral teeth, which seem to have pierced the thin surface,  $\times \frac{5}{2}$ . Sloly. Barnstaple Athenæum.
9. Cast of a perfect, but very doubtful specimen, showing the teeth,  $\times 2$ . 9 *a*. Hinge-line,  $\times 7$ . Barnstaple. Museum of Practical Geology.

### CTENODONTA (KOENENIA), cf. OBSOLETA, *Goldfuss*, sp. (Page 106.)

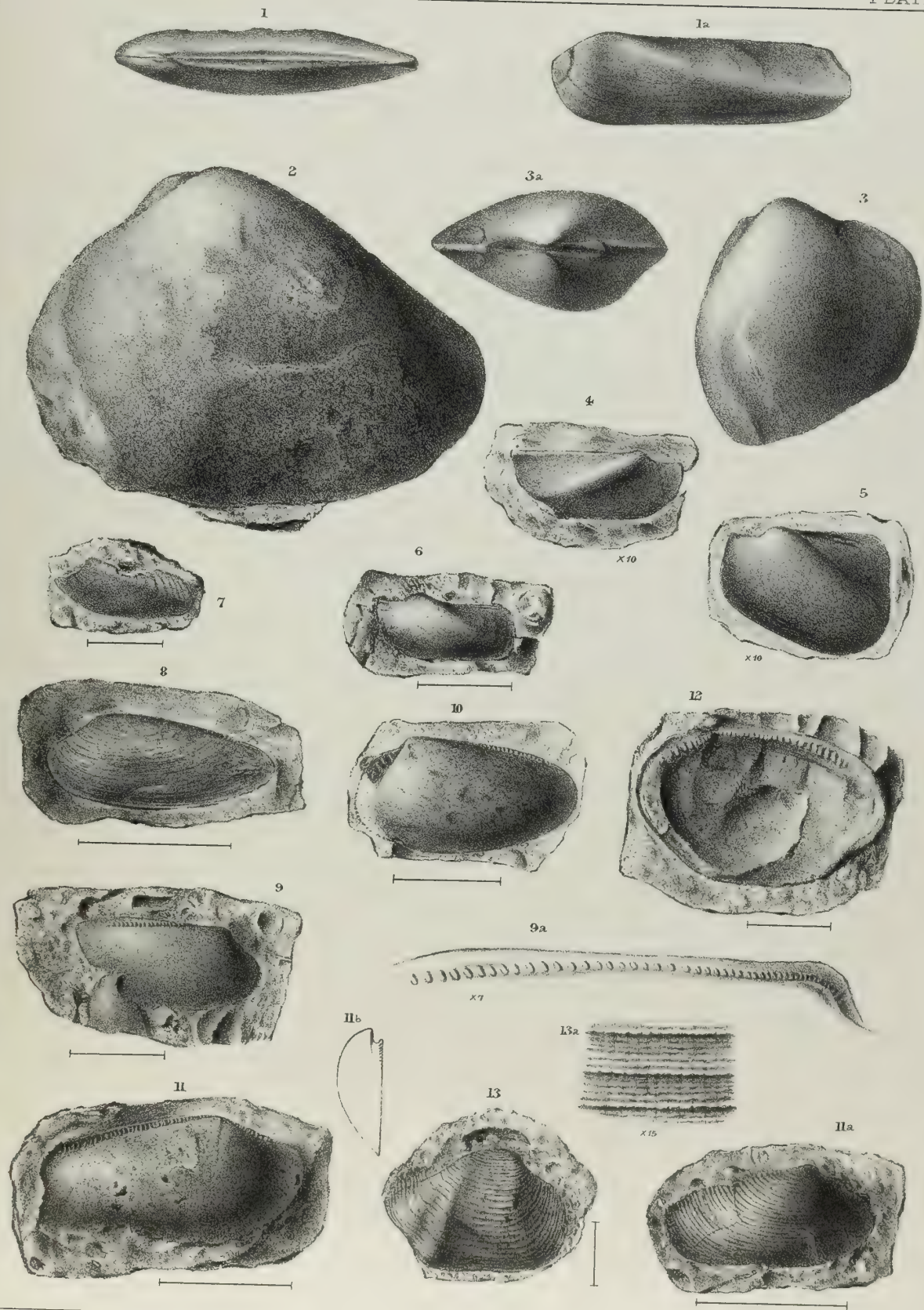
10. Cast, showing the large anterior teeth, but having lost almost all the posterior part of the hinge,  $\times 2$ . Baggy Point. Museum of Practical Geology.

### NUCULITES? LATISSIMUS, *Phillips*, sp.? (Page 107.)

11. Cast of right valve, showing the teeth and the clavicular ridge,  $\times 2$ . 11 *a*, surface of the same valve drawn from a wax impression of its mould,  $\times \frac{3}{2}$ . 11 *b*. End view,  $\times 2$ . Fremington. Barnstaple Athenæum.

### CTENODONTA (PALÆONEILO) LIRATA, *Phillips*, sp. (Page 100.)

12. Interior of right valve, showing hinge,  $\times 3$ . Baggy. Museum of Practical Geology.
13. Right valve, vertically compressed,  $\times 2$ . 13 *a*. Portion of surface, the longitudinal lines of which are probably induced by pressure,  $\times 15$ . Barnstaple. Woodwardian Museum.









## PLATE XIII.

### CTENODONTA (PALÆONEILO) LIRATA, *Phillips*, sp. (Page 100.)

FIG.

1. Phillips's type specimen, which is abraded in front and defective behind. Pilton. Museum of Practical Geology.
2. Specimen, showing the posterior ridge and concavity, and with indications of the hinge-teeth, which have partially pierced the shell-surface,  $\times 2$ . Bradiford. Barnstaple Athenæum.
3. Specimen, very greatly elongated by compression,  $\times \frac{3}{2}$ . Saunton. Barnstaple Athenæum.
4. Specimen, figured by Phillips as *Pullastra antiqua*, Sowerby. Barnstaple. Museum of Practical Geology.

### CTENODONTA ? (PALÆONEILO) ANTIQUA, *Sowerby*, sp. (Page 102.)

5. Sowerby's original type of *Pullastra antiqua*; the figure is drawn from the cast and mould of the specimen combined,  $\times 2$ . Marwood. Woodwardian Museum.

### CTENODONTA ? ELLIPTICA, *Phillips*, sp. (Page 103.)

6. Large specimen, showing the ornament,  $\times \frac{3}{2}$ . Bradiford. Barnstaple Athenæum.

### LEPTODESMA CITIMUM, n. sp. (Page 120.)

7. Large specimen, imperfect on the wings. 7 a. Anterior view. Marwood. Museum of Practical Geology.

### MYTILARCA ? MODIOLOIDES, n. sp. (Page 117.)

8. Specimen with the margins somewhat obscured by matrix. Braunton. Museum of Practical Geology.

### COBRACEPHALUS ANGULOSUS, n. sp. (Page 119.)

9. Specimen of a right valve, showing the angulated character of the contour and the nature of the ornament,  $\times 3$ . 9 a. Portion of surface,  $\times 15$ . Top Orchard Quarry. Woodwardian Museum.

### CUCULLEA UNILATERALIS, *Sowerby* ? (Page 109.)

10. Specimen of a small cast of the closed valves of a very short variety. 10 a. Upper view. Marwood. Museum of Practical Geology.
11. Small and doubtful specimen with strong growth-lines,  $\times \frac{4}{3}$ . Pilton. Porter Collection.

### MODIOLA AMYGDALINA, *Phillips*. (Page 114.)

12. Cast of a left valve,  $\times 2$ . Fremington. Porter Collection.

### DIGONIOMYA ELEGANS, n. sp. (Page 117.)

13. Large specimen of a cast, showing the dorsal depression and the posterior elongation. Croyde. Museum of Practical Geology.

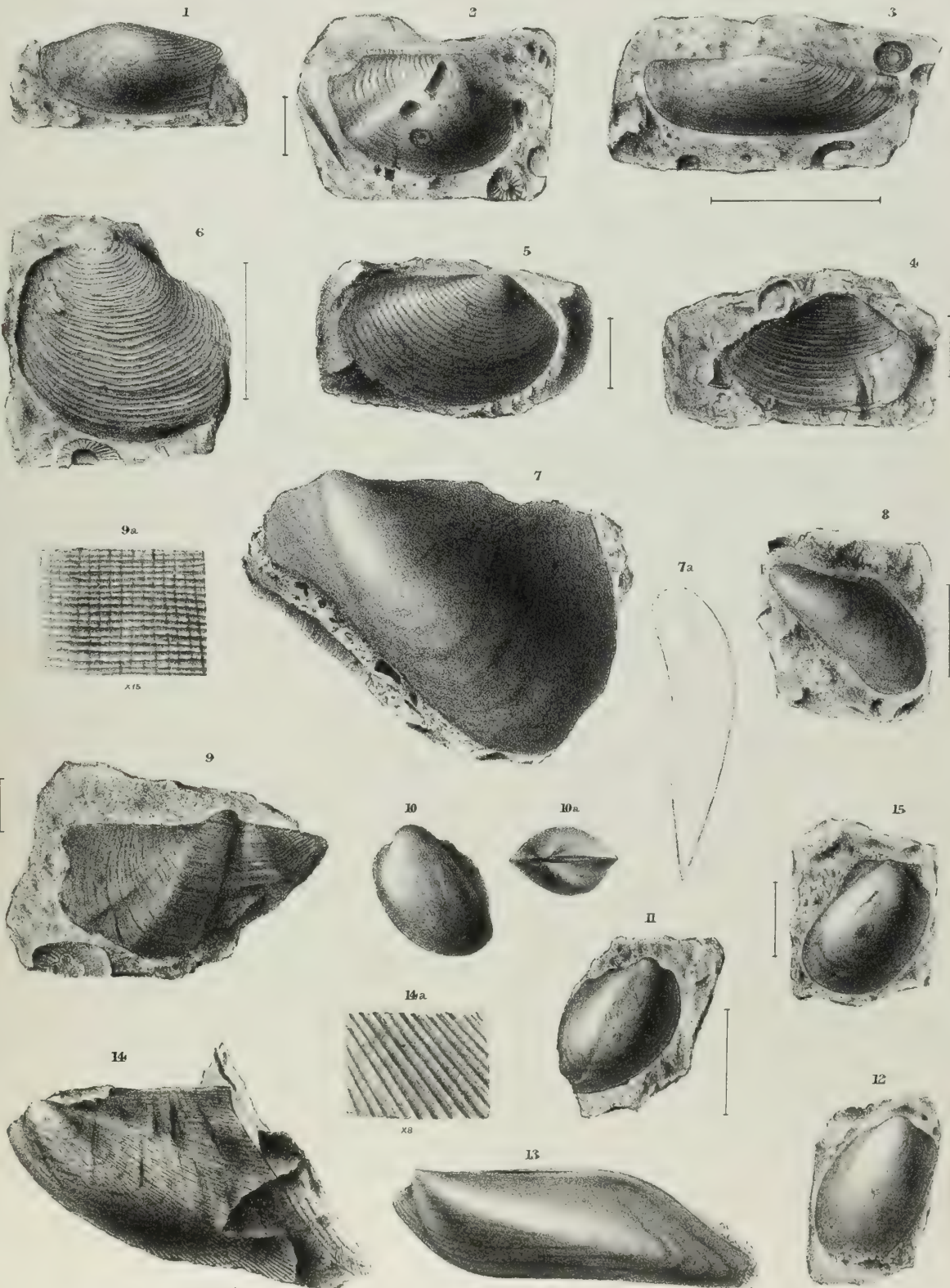
### PTYCHOPTERIA DAMNONIENSIS, *Sowerby*, sp. (Page 126.)

14. Large and peculiarly shaped example, somewhat distorted,  $\times \frac{4}{3}$ . 14 a. Portion of surface,  $\times 8$ . Barnstaple. Woodwardian Museum.

### AVICULOPECTEN GRANULOSUS, *Phillips*, sp. (Page 130.)

15. Specimen of a cast, showing the wings,  $\times 2$ . Pilton. Porter Collection.











## PLATE XIV.

### LEPTODESMA, sp. (Page 121.)

FIG.

1. Left valve, imperfect and probably somewhat distorted. Pilton. Barnstaple Athenæum.

### LEPTODESMA CULTELLATUM, n. sp. (Page 121.)

2. Left valve, showing the fine striation,  $\times 2$ . 2a. Corresponding right valve from the same slab, doubtless belonging to the same specimen, showing the fine striation of the surface of the back, and the wings,  $\times 2$ . Braunton. Museum of Practical Geology.
3. Two valves in contact, lying obliquely in the matrix, and somewhat obscured,  $\times 2$ . Pilton. Porter Collection.

### LEPTODESMA ANATINUM, n. sp. (Page 122.)

4. Cast of a right valve, very imperfect, but showing the umbo, hinge-line, wings, and anterior muscle-scar,  $\times 2$ . Pilton. Porter Collection.
5. Left valve, injured above, but showing the wings and the character of the surface,  $\times 2$ . Pilton. Porter Collection.
6. Another imperfect left valve, in which the surface-ornament is obliterated, but the shape partially well shown. Pilton. Porter Collection.

### LEIOPTERIA CONRADI, Hall? (Page 124.)

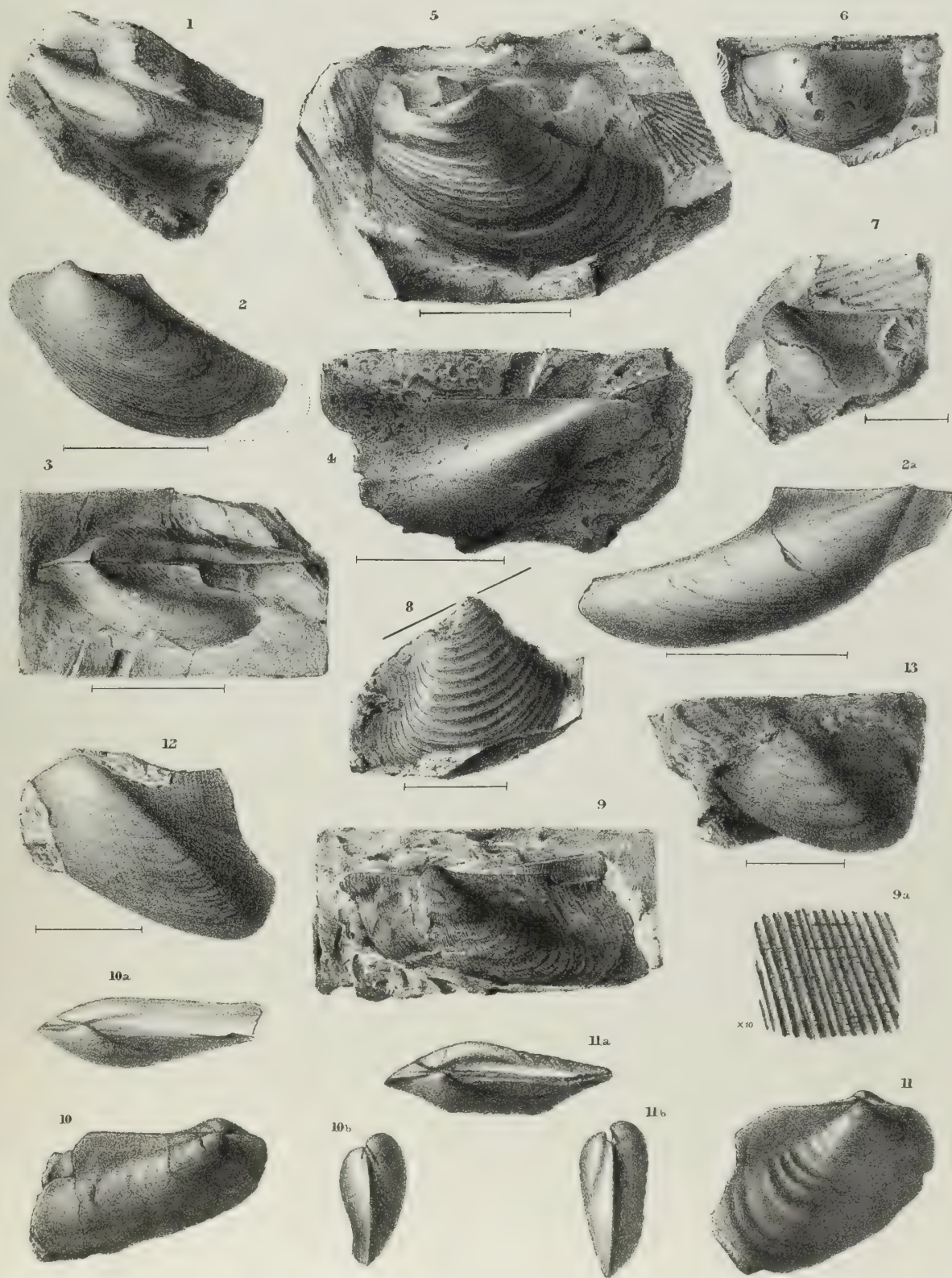
7. Specimen of the left valve, wanting surface,  $\times \frac{3}{2}$ . Barnstaple. Woodwardian Museum.

### LEIOPTERIA MURATA, n. sp. (Page 125.)

8. Specimen of right valve, very defective, but showing the ornament and the general shape of part of the skull,  $\times 2$ . Barnstaple. Woodwardian Museum.

### PTYCHOPTERIA DAMNONIENSIS, Sowerby, sp. (Page 126.)

9. Large specimen, retaining the surface, which shows that the fine radiations on the hind wing are sometimes partially obliterated, and having an angular, but somewhat injured front wing. 9a. Portion of surface,  $\times 10$ . West Angle Bay, Pembrokeshire. Museum of Practical Geology.
10. Sowerby's original type, which is almost a cast. The marked convexity of the hind wing in the specimen is not shown in the figure. 10a. Upper view. 10b. Anterior view. Marwood. Woodwardian Museum.
11. Cast of a much less oblique and transverse variety. 11a. Upper view. 11b. Anterior view. Marwood. Museum of Practical Geology.
12. Specimen, retaining surface, but obscured by matrix in front, accurately agreeing in character with Phillips's figure of *Avicula cancellata*,  $\times 2$ . Kingdon's, Shirwell. Barnstaple Athenæum.
13. A similar specimen which more nearly approaches fig. 11 in shape, and in which the minute concentric ornament predominates,  $\times 2$ . Top Orchard. Barnstaple Athenæum.









## PLATE XV.

### PTERINOPECTEN POLYTRICHUS, *Phillips*, sp. (Page 132.)

FIG.

1. Very large but imperfect left valve, showing the radiations and some trace of transverse ornament. Croyde Bay. Museum of Practical Geology.

### PTERINOPECTEN HALLII, n. sp. (Page 134.)

2. Very perfect left valve, set very slightly obliquely in the matrix, and slightly defective on the anterior wing,  $\times 3$ . 2 a. Portion of the surface,  $\times 5$ . Pilton. Porter Collection.
3. Left valve, with a large and undefined hind wing, defective in front,  $\times \frac{5}{2}$ . Meer Top. Barnstaple Athenæum.
4. Left valve of a large shell, showing the front wing, but defective below,  $\times \frac{5}{2}$ . Petherwyn. Museum of Practical Geology.
5. Left valve, wanting the wings,  $\times \frac{5}{2}$ . Top Orchard. Barnstaple Athenæum.
6. Left valve, wanting the wings, but showing the posterior side without rays and with stronger concentric threads,  $\times 3$ . Top Orchard, Barnstaple Athenæum.

### CRENIPECTEN ? AURITUS, n. sp. ? (Page 139.)

7. Doubtful and indistinct left valve, with small wings and very numerous rays, which do not seem to alternate, but of which every third or fourth seems rather stronger than the rest. The surface is removed except round the edges,  $\times 2$ . Smoking House Lane. Porter Collection.

### PTERINOPECTEN SCABRIRADIANS, n. sp. (Page 135.)

8. Doubtful left valve, imperfect in front, and somewhat obscured by vertical crushing and exfoliation of surface, but showing the fine, sharp, and nearly equal distinct ribs and faint signs of transverse threads,  $\times 3$ . Pilton. Porter Collection.
9. Defective right valve, showing the interrupted radiations and the deeply-notched anterior wing,  $\times 3$ . Pilton. Porter Collection.

### PTERINOPECTEN AUSTENI, *F. A. Römer*, sp. (Page 136.)

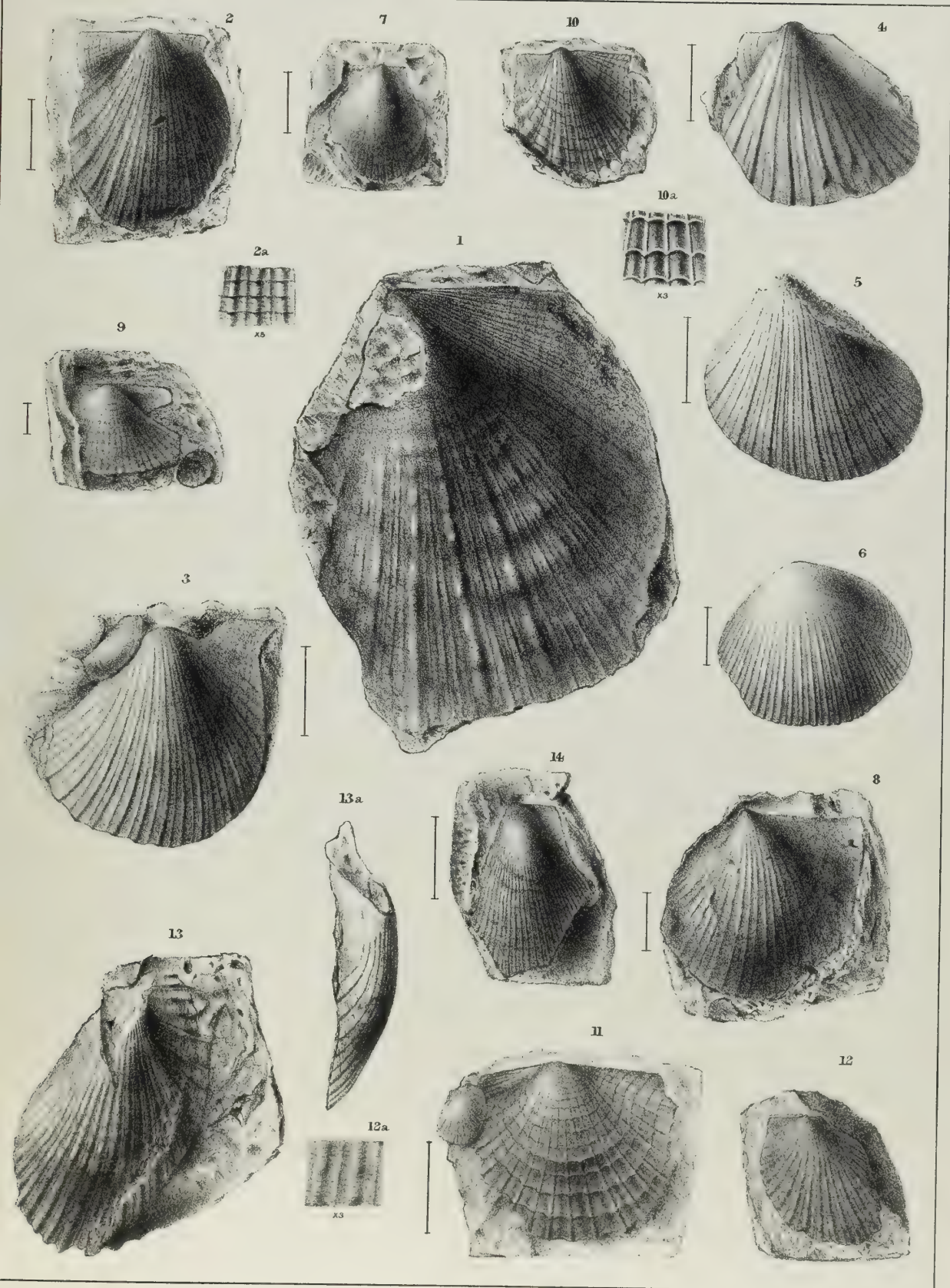
10. Very large left valve, showing the wings, the spiny margin, and the peculiar ornament. 10 a. Portion of surface,  $\times 3$ . Pilton. Porter Collection.
11. Left valve, drawn from a gutta-percha cast, and showing the foliaceous growth-lines,  $\times 2$ . Barnstaple. Woodwardian Museum.

### PTERINOPECTEN MUNDUS, n. sp. (Page 137.)

12. Left valve, showing the hinge-area and front wing. 12 a. Portion of surface,  $\times 3$ . Barnstaple. Woodwardian Museum.
13. Large but very much distorted specimen. 13 a. Lateral view. Barnstaple. Woodwardian Museum.

### ACTINOPTERIA RUDIS, *Phillips*, sp. (Page 131.)

14. Left valve, defective below, and showing a smooth posterior wing, the smoothness of which appears caused by the obliteration of the surface,  $\times 2$ . Barnstaple. Woodwardian Museum.









## PLATE XVI.

### AVICULOPECTEN TRANSVERSUS, *Sowerby*, sp. (Page 127.)

FIG.

1. Specimen of an imperfect left valve, retaining ornament,  $\times \frac{7}{4}$ . 1 a. Portion of surface,  $\times 10$ . Barnstaple. Woodwardian Museum.
2. Right valve, figured by Phillips, vertically compressed, but showing wings. Brushford. Museum of Practical Geology.
3. Portion of right valve, showing the ornament and the anterior wing. Pilton. Porter Collection.
4. Right valve, nearly perfect, but vertically compressed, showing the wings. Barnstaple. Woodwardian Museum.

### AVICULOPECTEN NEXILIS, *Sowerby*, sp. (Page 129.)

5. Very imperfect specimen of the left valve,  $\times 3$ . Top Orchard. Barnstaple Athenæum.
6. More perfect, but rather doubtful left valve, defective at the wings,  $\times 2$ . Braunton. Barnstaple Athenæum.

### PLEURONECTITES PILTONENSIS, n. sp. (Page 140.)

7. Nearly perfect right valve, showing the smooth surface, striated wing, and produced anterior margin,  $\times 2$ . Pilton. Porter Collection.
8. Mould of a very large right valve, showing the posterior wing. Pilton. Porter Collection.
9. Right valve, which is much less oblique, a difference which is probably due to distortion, but if not would be, according to de Koninck, of specific value,  $\times \frac{3}{2}$ . Top Orchard. Barnstaple Athenæum.
10. Left valve of a specimen, perhaps of the same species, but, if so, much distorted,  $\times \frac{3}{2}$ . Bradiford. Barnstaple Athenæum.
11. Very similar but shorter left valve,  $\times \frac{3}{2}$ . Raleigh. Barnstaple Athenæum.

### PLEURONECTITES LEPIS, n. sp. (Page 142.)

12. Specimen of an imperfect right valve,  $\times 2$ . Pilton. Porter Collection.
13. Specimen of the left valve,  $\times 2$ . Top Orchard. Barnstaple Athenæum.

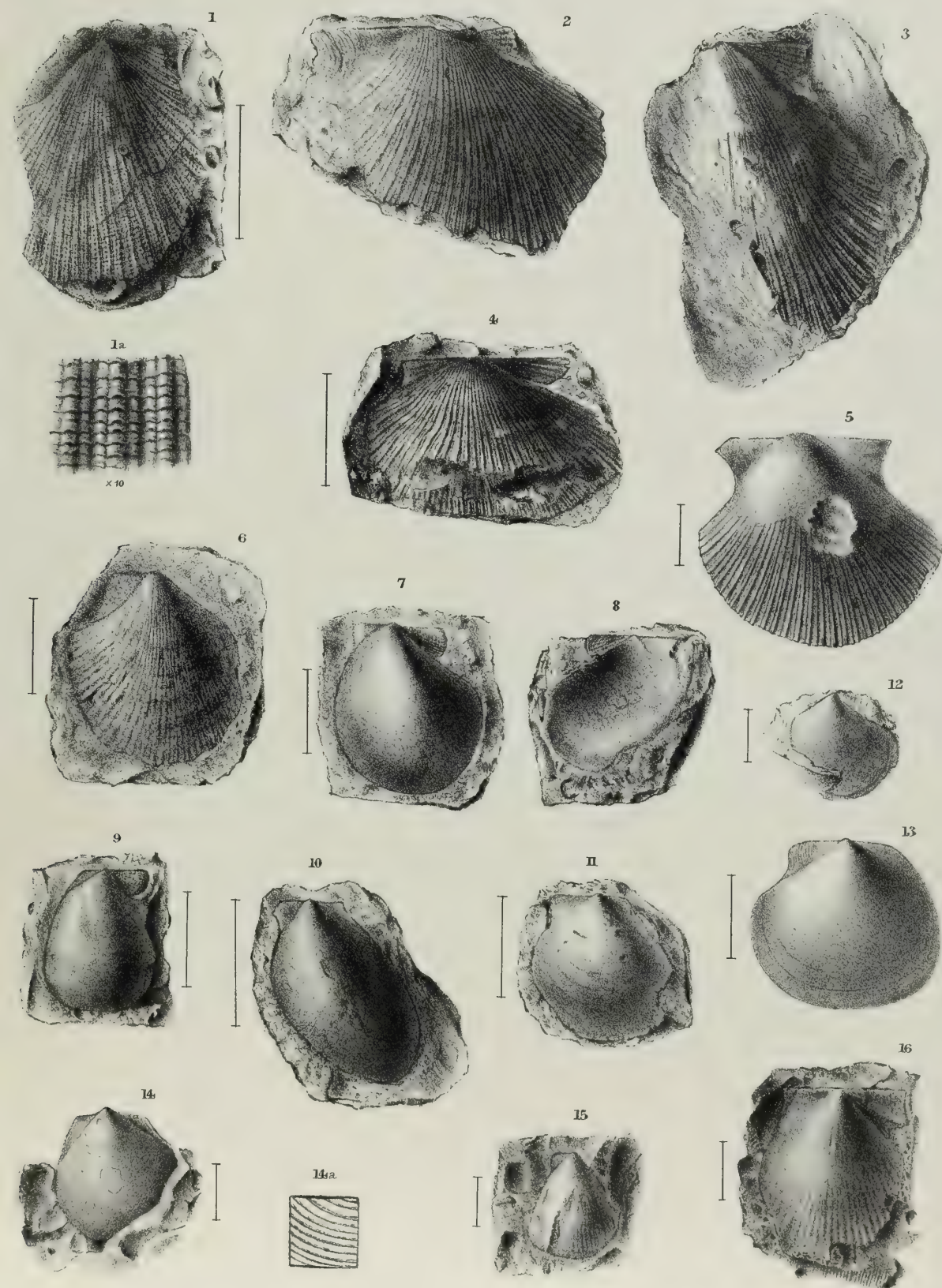
### PLEURONECTITES HICKSII, n. sp. (Page 142.)

14. Specimen of the left valve  $\times \frac{5}{2}$ . Bradiford. Barnstaple Athenæum.

### CRENIPECTEN? AURITUS, n. sp. (Page 139.)

15. A very imperfect left valve,  $\times 2$ . Bradiford. Barnstaple Athenæum.
16. Right valve, imperfect below, but showing the ornament and the wings,  $\times 3$ . Top Orchard. Barnstaple Athenæum.















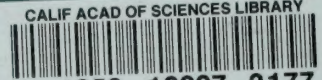








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